



DOCUMENT SECTION

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Reference

TM 9-350

WAR DEPARTMENT TECHNICAL MANUAL

U.S. ARMY MILITARY HISTORY INSTITUTE
CARLISLE BARRACKS, PA 17013-5006

155-MM GUN M2; CARRIAGE M1 AND M1A1; GUN MOUNT M13; HEAVY CARRIAGE LIMBER M2 AND M5; AND FIRING PLATFORM M1

DECLASSIFIED
Auth: NND 785097
By: NNEP - NARS 11-3-78
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WAR DEPARTMENT
U.S. ARMY
WASHINGTON, D.C.

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23b, AR 380-5, 15 March 1944.)

WAR DEPARTMENT

7 MAY 1945

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WAR DEPARTMENT TECHNICAL MANUAL

TM 9-350

This TM supersedes TM 9-350, dated 11 May 1942; Changes No. 1, dated 31 Jul 42; Changes No. 2, dated 29 Oct 42; Changes No. 3, dated 19 Aug 43; Changes No. 4, dated 9 Nov 43; Changes No. 5, dated 20 Apr 44; OFSTB 350-1, dated 11 Jun 43; WDTB 9-350-4, dated 19 Jan 44; WDTB 9-350-5, dated 7 Mar 44; WDTB 9-350-6, dated 10 Aug 44. This TM supersedes portions of OFSTB 350-3, dated 26 Aug 43; WDTB ORD FE9, dated 2 Aug 44; WDTB ORD FE10, dated 18 Jun 43; WDTB ORD 65, dated 16 Mar 44; WDTB ORD 113, dated 23 Jun 44; WDTB ORD 135, dated 3 Aug 44; WDTB ORD 206, dated 28 Sep 44; which apply to the materiel covered in this TM; however, these TB's remain in force until incorporated in all other affected TM's or specifically rescinded.

155-MM GUN M2; CARRIAGE M1 AND M1A1; GUN MOUNT M13; HEAVY CARRIAGE LIMBER M2 AND M5; AND FIRING PLATFORM M1



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WAR DEPARTMENT,
Washington 25, D. C., 7 MAY 1945.

TM 9-350, 155-mm Gun M2; Carriage M1 and M1A1; Gun Mount M13; Heavy Carriage Limber M2 and M5; and Firing Platform M1,
is published for the information and guidance of all concerned.

[A.G. 300.7 (8 Apr 44)
O.O. 300.7/3556]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

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(For explanation of symbols, see FM 21-6.)

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PART ONE - INTRODUCTION

Section I

GENERAL

1. SCOPE.

a. This manual is published for the information of the using arms and services.

b. In addition to a description of the 155-mm gun M2; carriage M1 and M1A1; heavy carriage limber M2 and M5, firing platform M1, and gun motor mount M13, this manual contains technical information required for the identification, use, and care of the weapon, ammunition, and accessory equipment.

c. In all cases where the nature of the repair, modification, or adjustment is beyond the scope or facilities of the unit, the responsible ordnance service should be informed so that trained personnel with suitable tools and equipment may be provided, or proper instructions issued.

2. RECORDS.

a. Artillery Gun Book.

(1) The Artillery Gun Book (O.O. Form 5825) is used for the purpose of keeping an accurate record of the materiel. It must always remain with the materiel regardless of where it may be sent. The book is divided as follows: Record of assignment; battery commander's daily gun record; inspector's record of examination. This book should be in the possession of the organization at all times, and its completeness of record and its whereabouts are the responsibility of the battery commander. It must also contain date of issuance of the materiel, by whom used, and the place where issued. If a new gun is installed on the carriage, all data recorded in the old book with references to sights, mounts, etc., must be copied into the new book before the old book is relinquished. If the gun book is lost, it should be replaced at once and all entries brought up to date. **NOTE:** *Record of assignment data must be removed and destroyed prior to entering combat.*

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(2) The Artillery Gun Book which has become separated from the weapon to which it pertains and for which efforts to locate the weapon have failed, should be forwarded immediately to the Office, Chief of Ordnance, Field Service, Maintenance Division, Artillery Branch, Washington 25, D. C. Inquiries concerning a lost gun book should also be forwarded to the same office. All available information concerning the weapon and its past history should be forwarded with the inquiry. If the lost book is not turned in, any additional information available will be furnished for use in preparing a duplicate book.

(3) Complete instructions on how to make entries in the artillery gun book are contained therein. It is absolutely essential that the gun book entries be kept complete and up to date. In order to facilitate proper maintenance of the cannon and its related materiel (that is, carriage, recoil mechanism, and associated fire control equipment) and to avoid unnecessary duplication of repairs and maintenance, the following additional entries are to be made in the gun book.

(a) A record of completed modification work orders. This record should show the date completed and bear the signature of the officer or mechanic responsible for completion of the modification.

(b) A record of seasonal change of lubricants and change of recoil oil in sufficient detail to prevent duplication and afford proper identification by the inspector.

(4) The estimated accuracy life of this cannon is 1,500 rounds.

b. Field report of accidents. When an accident involving ammunition occurs during practice, the incident will be reported as prescribed in AR 750-10 by ordnance officer under whose supervision ammunition is maintained or issued. Where practicable, reports covering malfunctions of ammunition in combat will be made to the Chief of Ordnance, giving the type of malfunction, type of ammunition, the lot number of complete rounds or separate loading components, and condition under which fired.

c. Unsatisfactory equipment report. Suggestions for improvement in design, maintenance, safety, and efficiency of operation, prompted by chronic failure or malfunction of the weapon, spare parts or equipment, should be reported on WD AGO Form No. 468, Unsatisfactory Equipment Report, with all pertinent information necessary to initiate corrective action. The report should be forwarded to the Office, Chief of Ordnance, Field Service Division, Maintenance Branch, through command channels in accordance with instruction No. 7 on the form. Such suggestions are encouraged in order that other organizations may benefit. If WD AGO Form No. 468 is not available, refer to TM 37-250 for list of data required on Unsatisfactory Equipment Report.

Part One — Introduction

Section II**DESCRIPTION AND DATA****3. GENERAL.**

a. The 155-mm gun M2 is used as a heavy field weapon and is also classed as secondary armament for seacoast defense. The 155-mm gun M2 is mounted on three types of mounts, namely; the heavy field carriage M1 or M1A1 (figs. 1, 2, and 3), gun motor carriage T83 (figs. 4 and 5) and the firing platform M1 (fig. 6).

b. The 155-mm gun carriages M1 and M1A1 are heavy field carriages and are equipped with a bogie assembly at the front of the carriage, which is used to lower the carriage to the firing position and also to raise the carriage to the traveling position. The carriage is limbered by either the heavy limbers M2 or M5, or it can be towed without the use of the limber by being semi-trailed. When emplaced, removable spades are installed on the carriage and on the rear ends of the trails. Air brakes are provided for use during transit, and hand brakes are applied on the front bogie wheels when the weapon is parked.

c. The firing platform M1 is a circular platform designed to enable all-around fire. When mounted on the firing platform M1, the same materiel is used that is used with the heavy gun carriage M1 and M1A1. The weapon is rolled up into place and anchored on the bolster in the center of the platform (fig. 6).

d. The gun motor carriage M40 provides a highly mobile heavy artillery unit. When mounted on the 155-mm gun mount M13 for mounting on the gun motor carriage, only the gun, recoiling parts and top carriage of heavy field materiel are used (figs. 4 and 5).

e. The recoil mechanism is a hydro-pneumatic type with a variable recoil feature to offset differences of recoil at various degrees of elevation.

f. The 155-mm gun M2 may be equipped with either the firing mechanism M1 or the firing lock M17.

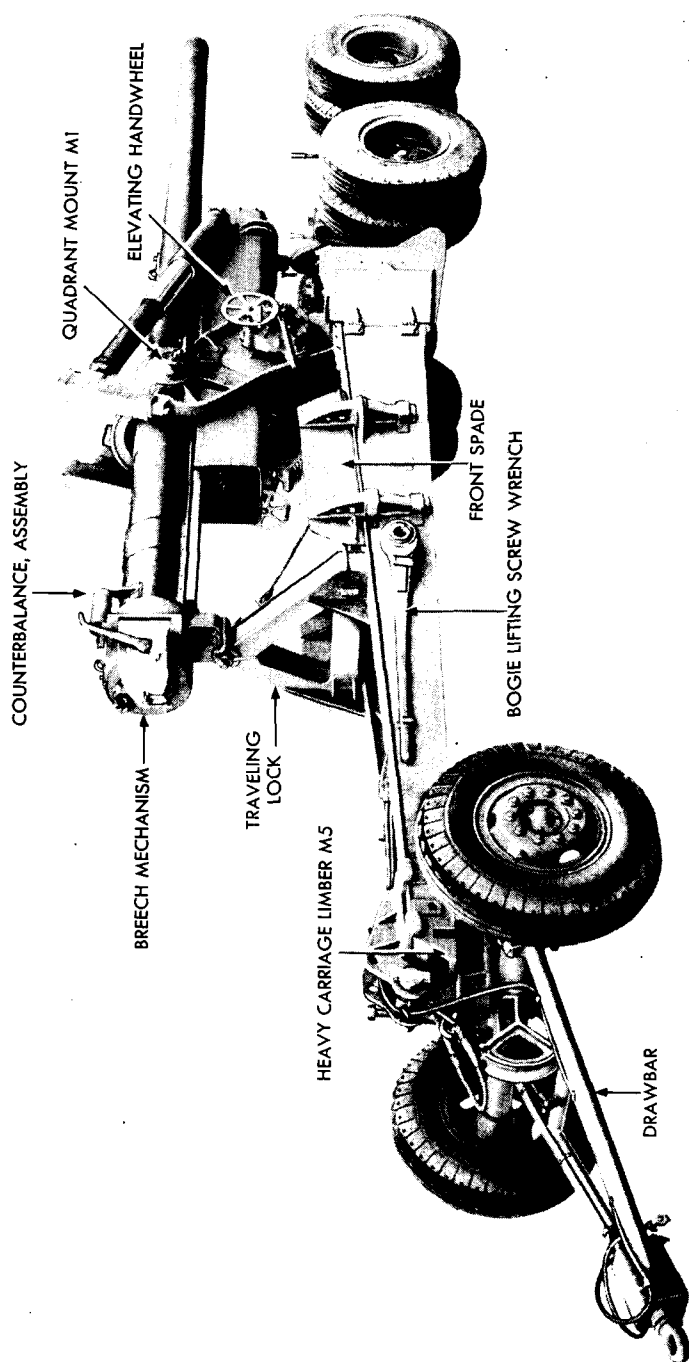
g. Separate loading ammunition is used, which is loaded and rammed into the gun by hand.

4. IDENTIFICATION INFORMATION.

a. The serial numbers required for records concerning the components of this materiel are the gun number, recoil mechanism number, carriage number, equilibrator number, and limber number.

b. **Gun serial number.** This number is stamped on the breech ring (fig. 7).

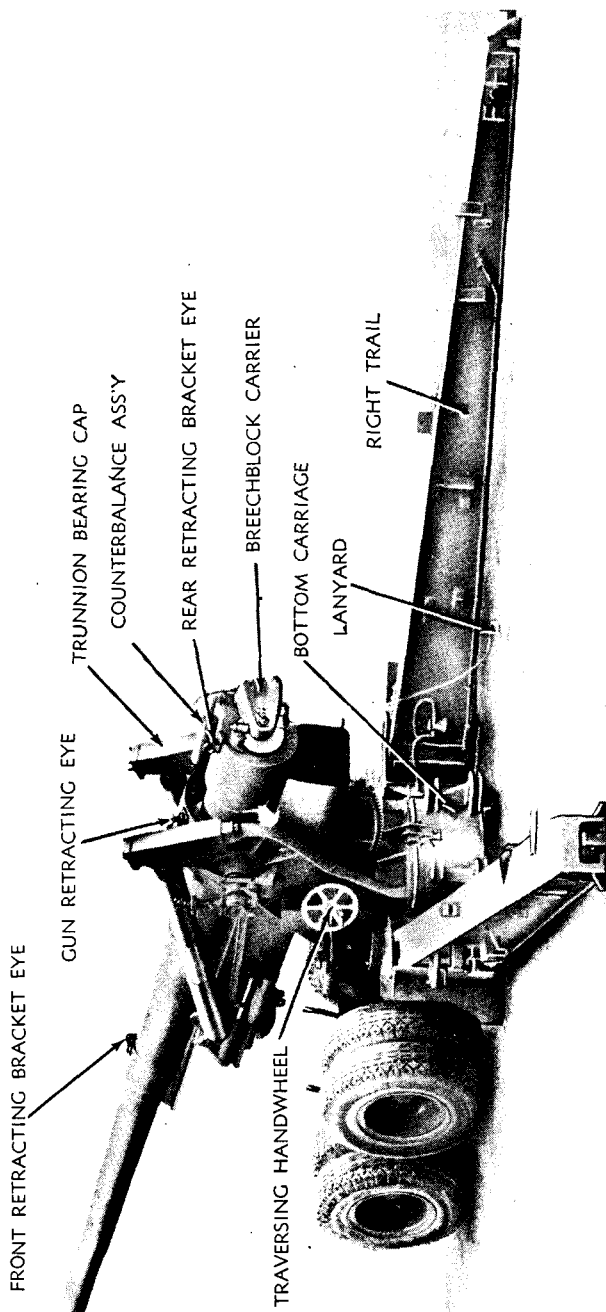
Part One — Introduction



RA PD 102413

Figure 1 — 155-mm Gun — Right Rear View

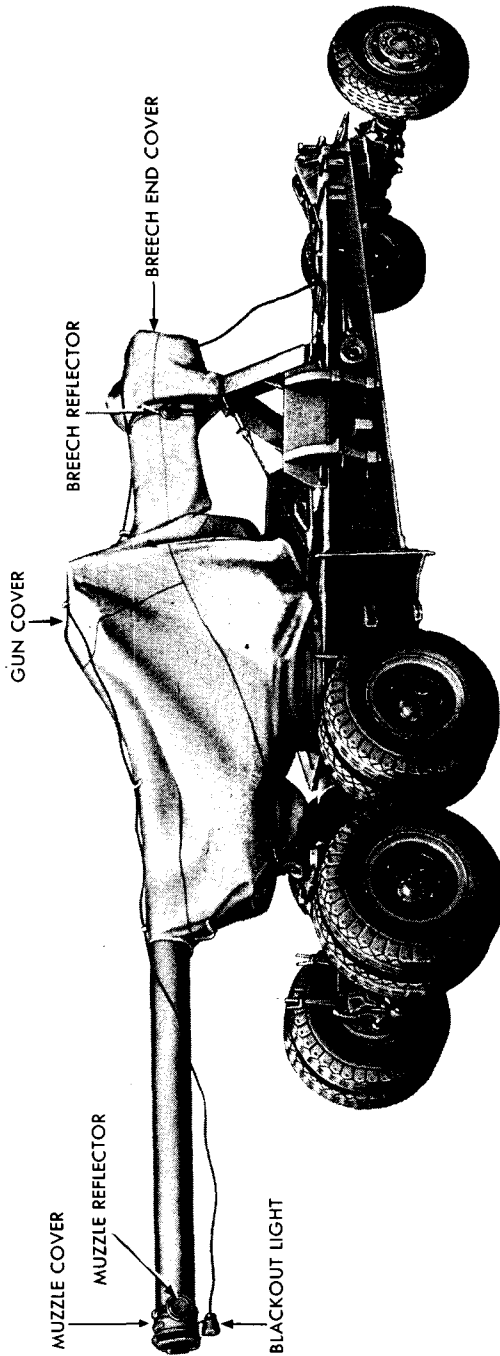
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RA PD 102381

Figure 2 — 155-mm Gun in Firing Position — Left Rear View

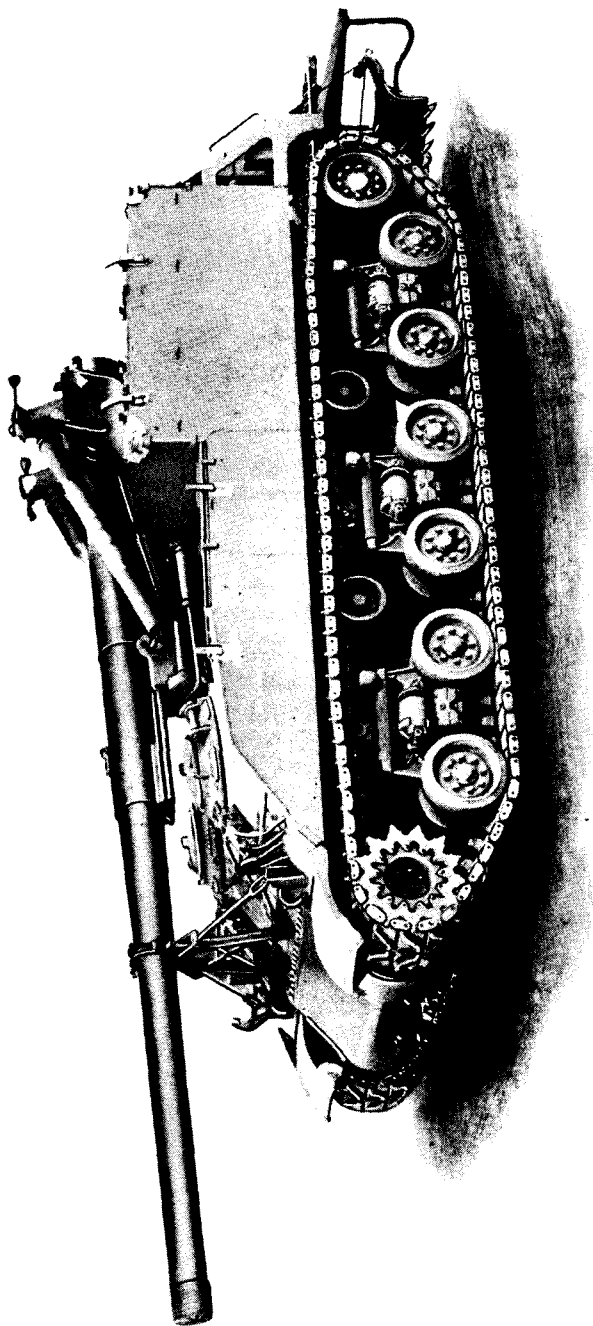
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RA PD 86555

Figure 3 — 155-mm Gun — Left Front View — With Covers Installed

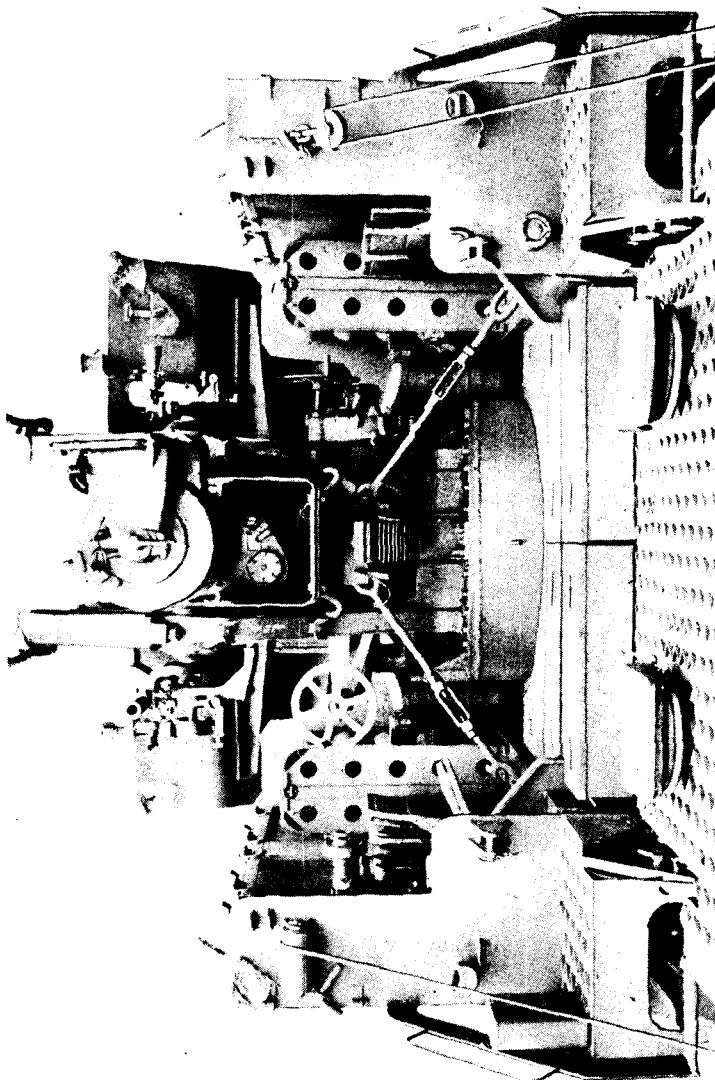
Part One — Introduction



RA PD 102384

Figure 4 — 155-mm Gun on Gun Mount M13 on Gun Motor Carriage M40 — Side View

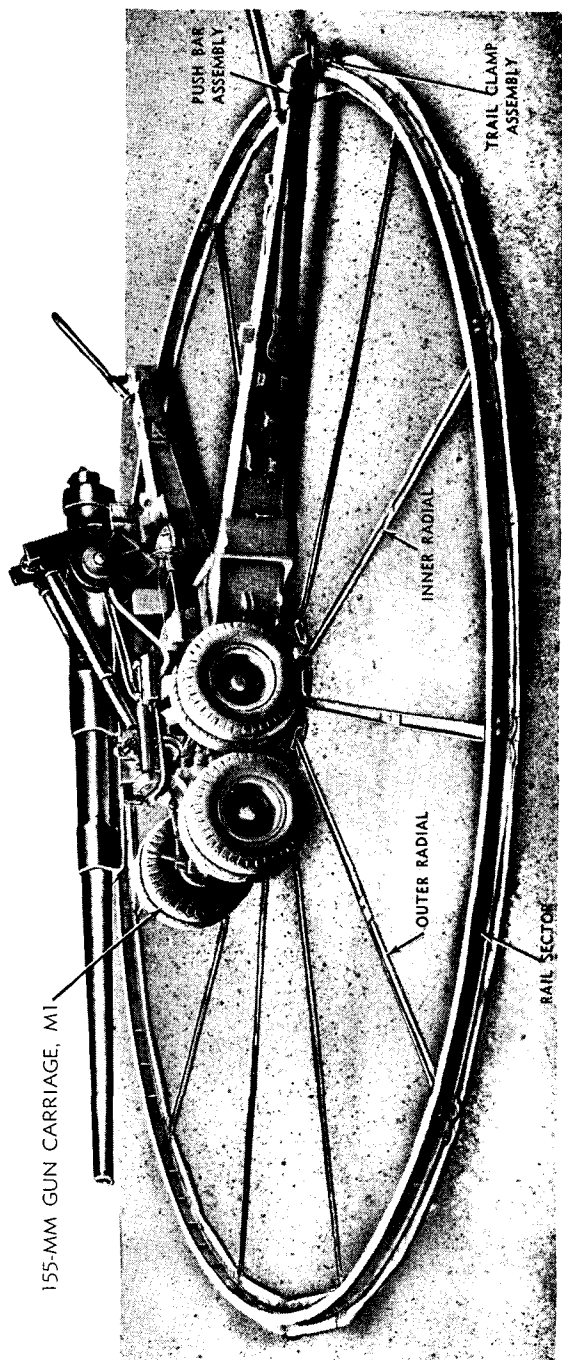
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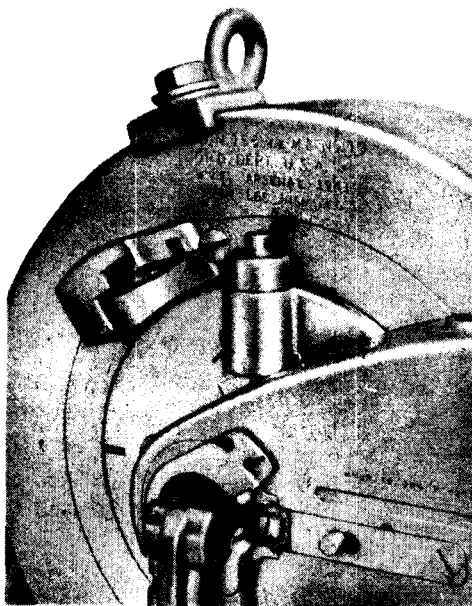
Figure 5 — 155-mm Gun on Gun Mount M13 on Gun Motor Carriage M40 — Rear View

Part One — Introduction



RA PD 19346

Figure 6 — Firing Platform



RA PD 104401

Figure 7 — Gun Serial Number

c. Recoil mechanism serial number. This number appears on a plate on right side of recoil mechanism (fig. 8).

d. Carriage serial number. This number appears on a plate on the right side of the top carriage (fig. 8).

e. Equilibrator serial number. The number appears on a plate screwed to the front head of the equilibrator (fig. 9).

f. Limber serial number (heavy carriage limber M2). This number appears on a name plate attached to the limber lift bracket (fig. 10).

g. Limber serial number (heavy carriage limber M5). This number appears on a nameplate attached to the limber lift bracket (fig. 11).

5. DIFFERENCE IN MODELS.

a. The 155-mm guns M1, M1A1, and M2 can be mounted on either the M1 or M1A1 gun carriages.

(1) The 155-mm guns M1 and M1A1 are identical with one exception, as follows:

(a) The 155-mm gun M1 has a breech ring bushing inserted in the breech ring. The breech mechanism female threads are cut in the breech bushing.

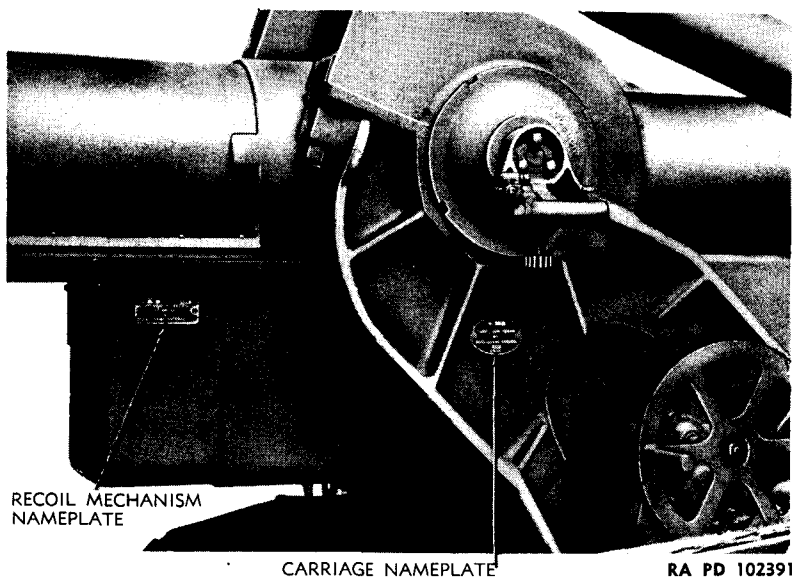
Part One — Introduction

Figure 8 — Recoil Serial Number and Carriage Serial Number

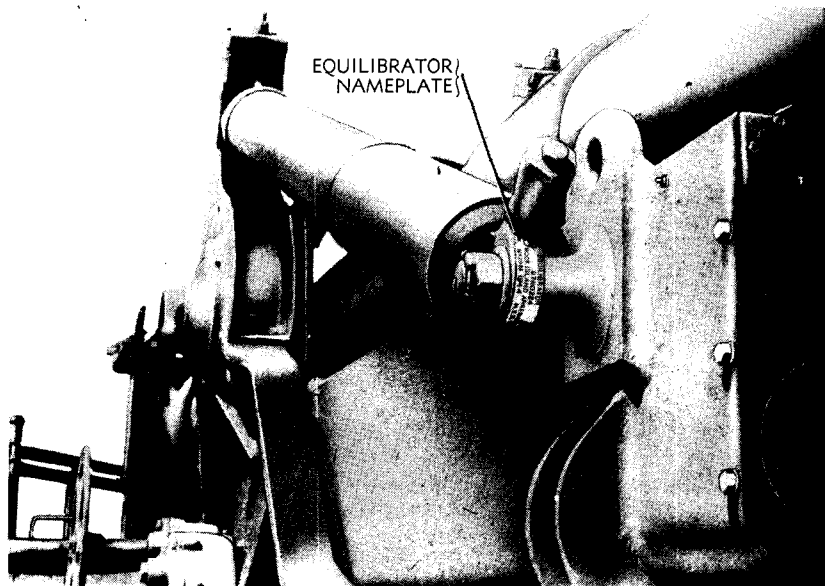
(b) The 155-mm gun M1A1 does not have a breech ring bushing; the breech mechanism female threads being cut directly in the breech ring.

(c) The 155-mm gun M2 is similar in construction to the 155-mm gun M1, i.e., the breech ring is fitted with a breech ring bushing and the breech mechanism female threads are cut in the breech ring bushing. In addition the 155-mm gun M2 has a slightly larger powder chamber than the guns M1 or M1A1.

b. The 155-mm gun carriage M1 is the standard carriage for these guns. The M1A1 carriages were the original test models reworked to be practically identical with the M1 carriage. Differences that remain between these two models are manufacturing details.

c. **Recoil mechanism.** The recoil mechanism M21 (formerly T54) used when mounting the 155-mm guns on the gun motor carriage M40 is the same as the recoil mechanism M3A1 used with the 155-mm guns on the heavy field carriage, with the exception that the cradle lock support, traveling lock boss and part of the supporting ribs have been removed to obtain required depression of the weapon. The recoil mechanism M21, cannot be used on the heavy field carriage.

d. **Limbers.** The heavy carriage limbers M2 and M5 are entirely different in design and operation (see pars. 85 and 86).

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RA PD 102390

Figure 9 — Equilibrator Serial Number**6. TABULATED DATA.****a. Data pertaining to 155-mm gun M2.****(1) GENERAL.**

Weight of gun (complete with breech mechanism).....	9,595 lb
Weight of tube assembly (barrel).....	9,190 lb
Length of tube	277.37 in.
Length of bore	cal. .45
Length of rifling	230.57 in.
Powder pressure (normal pressure with maximum charge in a new gun) lb per square in.....	40,000
Type of breechblock	Interrupted screw
Weight of breech mechanism	405 lb.
Type of firing mechanism	continuous pull percussion hammer
Ammunition	For complete ammunition data see section XXVII.

(2) PERFORMANCE.

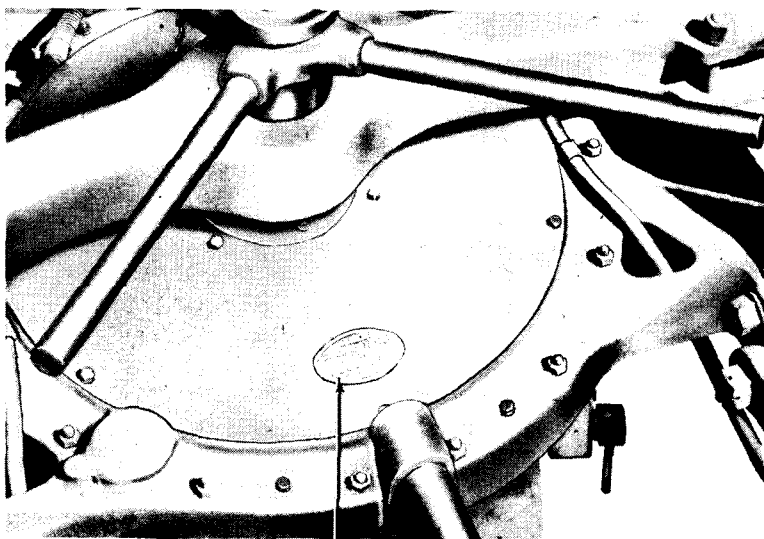
Muzzle velocity (average velocity with a new gun in feet per second):

Shell AP (Maximum zone charge)	2,745 fps
Shell HE (Maximum zone charge)	2,800 fps

Range: (Maximum)

AP Shell	24,075 yd
HE Shell	25,715 yd

Part One — Introduction



LIMBER NAMEPLATE

RA PD 102395

Figure 10 — Serial Number — Heavy Carriage Limber M2

Rate of fire:

Normal round 1 (per 2 minutes)

b. Data pertaining to carriage M1 or M1A1.**(1) GENERAL.**

Weights:

Gun and carriage (firing position) 27,700 lb

Gun and carriage (complete with accessories, traveling position)

(M2 limber) 29,900 lb

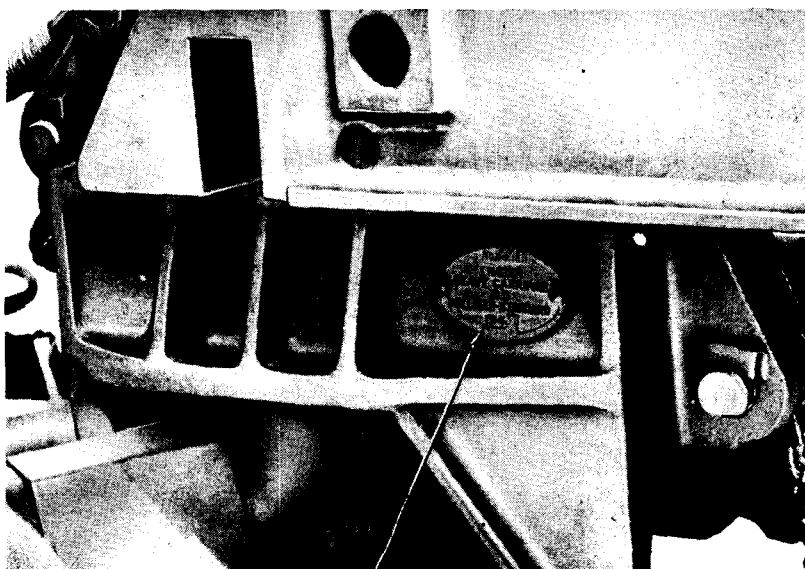
(M5 limber) 30,100 lb

Bogie 5,375 lb

Dimensions in traveling position, over-all: (with heavy carriage
limber M2)Length $34\frac{3}{8}$ ftWidth $98\frac{7}{8}$ in.Height $102\frac{1}{4}$ in.Dimensions in traveling position, over-all: (with heavy carriage
limber M5)Length $36\frac{5}{6}$ in.Width $98\frac{7}{8}$ in.

Height 107 in.

Part One — Introduction



LIMBER NAMEPLATE

RA PD 102394

Figure 11 — Serial Number — Heavy Carriage Limber M5

Towed by (with limber) M4 tractor, 18-ton, high speed
 (without limber) semi-trailed..... Truck, 7½ ton, 6 x 6,
 with semi-trailer

Recoil mechanism:

Model M3A1
 Maximum allowable recoil (approx) 70 in.
 Type of recoil mechanism Hydraulic
 Type of counterrecoil mechanism Hydropneumatic
 Weight 3,890 lb

Type of equilibrator Pneumatic

Tires:

Type and size 11 x 20 std
 Type and size tubes 10 x 20 std
 Air pressure: bogie assembly tires (normal: see par. 83).... 45 psi
 Air pressure: limber assembly tires (normal: see par. 83).... 65 psi
 Brakes, type mechanical, air or manually operated
 Wheel base of bogie 47 in.
 Tread (center-to-center of inside bogie wheels)..... 62 in.
 (center-to-center of outside bogie wheels)..... 88½ in.

*Part One — Introduction***(2) PERFORMANCE.****Limits of elevation:**

Maximum	63 deg 20 min
Depression	minus 1 deg 50 min
Limits of traverse in degrees right or left	30 deg
Elevation per turn of handwheel in mils	13.10 mils
Diameter of circle of emplacement	37 ft
Traverse per turn of handwheel	10 mils

(3) CAPACITIES.**Recoil oil:**

Reserve in replenisher (recoil) (normal)	1 $\frac{1}{5}$ pt
Reserve in recuperator (counterrecoil)	2 pt

c. Data pertaining to 155-mm gun mount M13 (T14).**(1) GENERAL.**

Mounted on gun motor carriage	M40
Recoil Mechanism	M21

(2) PERFORMANCE.**Limits of elevation.**

Maximum	45 deg
Depression	minus 5 deg

Limits of traverse.

Right	18 deg
Left	18 deg
Total traverse	36 deg

(Complete data will be supplied when available)**d. Data pertaining to limbers M2 and M5.**

	M2	M5
Width, over-all	95 $\frac{3}{4}$ in.	95 in.
Weight	2,000 lb.	2,200 lb

Tires:

Type and size	11 x 20 std.	11 x 20 std
Type and size tubes	11 x 20 std.	11 x 20 std

e. Data pertaining to sighting equipment.**Aiming post M1****Aiming post light M14****Gunner's quadrant M1 or M1918****Panoramic telescope M12 or M5A5****Telescope mount M18A1****Quadrant mount M1****Instrument light M5****Instrument light M12****Instrument light M19**

Part One — Introduction

f. Data pertaining to fire control equipment.

Aiming circle M1

Battery commander's telescope M65

g. Data pertaining to firing platform M1.

Total weight	8,332 lb
Diameter across rails	37 ft
Diameter of base ring	5 ft 7 in.
Diameter of pit	10 ft
Depth of pit	18 in.

h. Data pertaining to subcaliber equipment.

(1) GENERAL.

Model of gun	M1916
Model of mount	M10
Weight of gun and mount	88 lb
Length of bore	29.13 in.
Caliber	37-mm
Type of breechblock	Eccentric screw
Type of firing mechanism	Trigger
Recoil mechanism:	
Type of recoil	Hydrospring
Type of counterrecoil	Spring
Maximum allowable recoil	7 to 10 in.

Ammunition—For complete ammunition data, see section XXVII.

(2) PERFORMANCE.

Maximum rate of fire	35 rds per min.
Range	4,900 yd
Muzzle velocity	1,276 fps

Section III

TOOLS, PARTS, AND ACCESSORIES

7. ORGANIZATIONAL SPARE PARTS. A set of organizational spare parts is supplied to the using arms for field replacement of those parts most likely to become broken, worn, or otherwise unserviceable. The set will be kept complete by requisitioning new parts for those used. The parts comprising the set are listed below for information only; this list will not be used for requisitioning. The authority upon which requisitions are based is SNL D-24.

Part One — Introduction

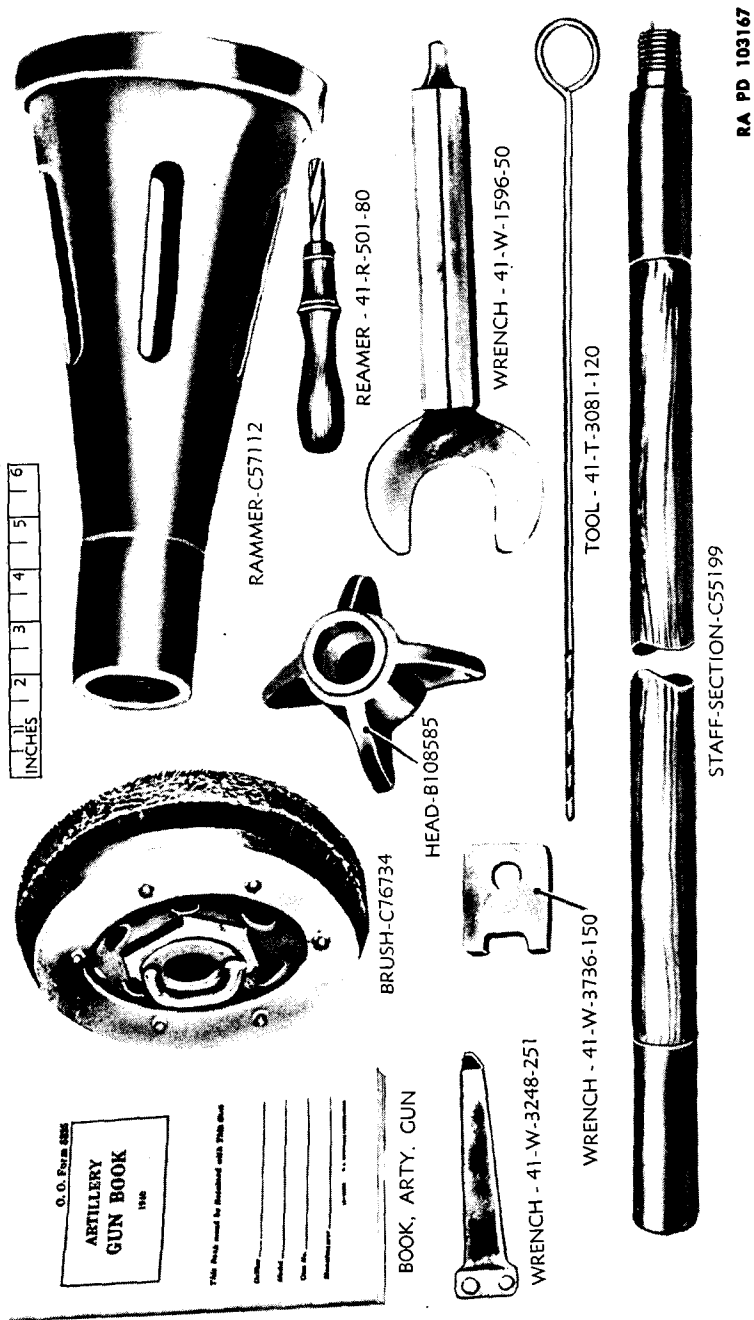
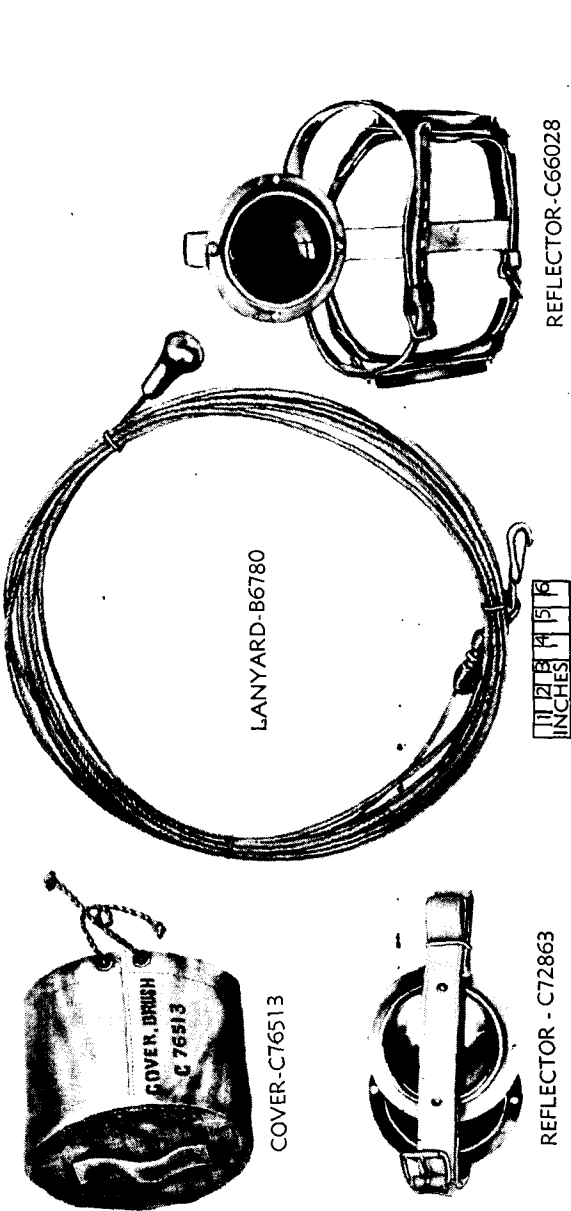


Figure 12 — Tools and Accessories

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Part One — Introduction



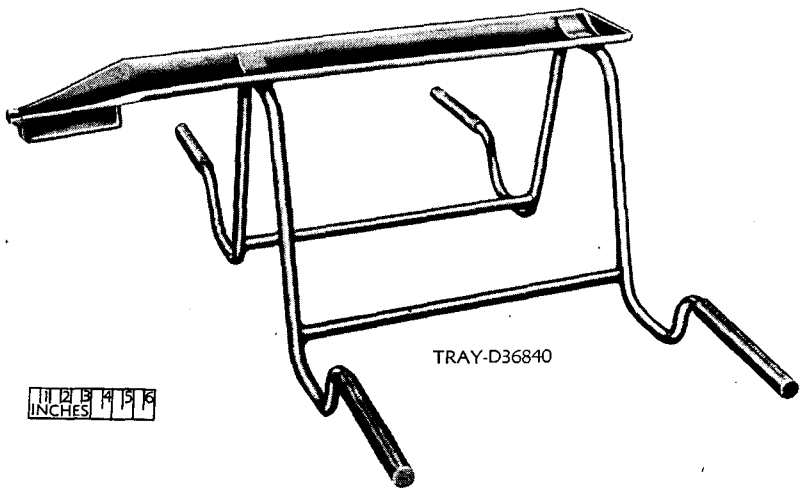
RA PD 103168

Figure 13 — Tools and Accessories

Part One — Introduction

Spare Part	Piece Mark	Figure No.
FOR GUN, 155-MM, M2		
GASKET, obturator spindle plug	A325	81
MECHANISM, firing, M1	C70485	86
PAD, gas check, obturator	C70484	81
PLUG, obturator spindle	B241	81
RING, inner, obturator	B19161	81
RING, split, front, obturator	B163356	81
RING, split, rear, obturator	B163357	81
FOR CARRIAGE, GUN, 155-MM, M1		
GASKET, wheel hub cap	B159927	102
WHEEL, assembly	C7107154	102
FOR MOUNT, GUN, 155-MM, T14		
None authorized.		
FOR LIMBER, CARRIAGE, HEAVY, M2		
None authorized.		
FOR LIMBER, CARRIAGE, HEAVY, M5		
PIN, safety, clamp bolt nut	A7104680	—
FOR MECHANISM, RECOIL, 155-MM GUN, M3 AND M3A1		
None authorized.		
FOR PLATFORM, FIRING, 155-MM GUN, M1		
BASE, trail clamp	B7201657	57
BOLT, special hinge w/shoulder, 1¼-7NC-2	B7159424	—
NUT, hex., semi-fin., ⅝-11NC-2	220080	—
NUT, hex., semi-fin., 1-8NC-2	220083	—
NUT, hex., semi-fin., 1¼-7NC-2	220090	—
PLANK, support, inner	A7201734	—
PLANK, support, intermediate	A7201735	—
PLANK, support, outer	A7201733	—
PLATE, rubbing, base, trail clamp	B7159428	—
SCREW, base timber support	A7201700	—
SCREW, cap, hex-hd., ⅝-11NC-2	202816	—
SCREW, cap, hex-hd., 1-8NC-2 x 2	D7201293	—
WASHER, beveled	A7201741	—
WASHER, lock, ¾ x ¼ x ⅜	103326	—
WASHER, lock, reg., ⅝ x 1⅜ x ⅝	103325	—
WASHER, lock, reg., ¾ x ¼ x ⅜	103326	—
WASHER, lock, reg., 1 x ⅝ x ¼	121326	—
WASHER, lock, reg., 1¼ x ⅜ x ¼	131035	—
WASHER, plain, ⅝	106267	—
FOR LOCK, FIRING, M17		
HAMMER, firing	B290426	91
PIN, face plate retaining	A7157504	91
PIN, firing	A338246	91
PLATE, face	B7157505	91
SPRING, firing	A338262	91
SPRING, firing pin return	A338222	91
SPRING, pull rod	A7157544	91
TRIPPER, firing hammer	B290433	—

Part One — Introduction



RA PD 22825

Figure 14 — Loading Tray

Spare Part	Piece Mark	Figure No.
FOR MECHANISM, FIRING, M1		
GUIDE, firing pin.....	A12256	87
HOLDER, primer	B8058	87
PIN, firing	A12258	87
PLUNGER, firing mechanism locking.....	A25625	87
SCREW, set, safety, 1/4-20NC-3	A12260	87
SHOE, firing pin housing set screw.....	A12268	87
SPRING, firing pin	A12261	87
SPRING, firing mechanism locking plunger.....	A25626	87

8. ACCESSORIES.

a. Accessories include the tools and equipment required for such disassembling and assembling as the using arm is authorized to perform, and for the cleaning and preservation of the gun, carriage, mount, limbers, firing platform, sighting and fire control equipment, ammunition, etc. They also include chests, covers, tool rolls, and other items necessary to protect the materiel when it is not in use, or when traveling. Accessories should not be used for purposes other than as prescribed, and when not in use should be properly stored.

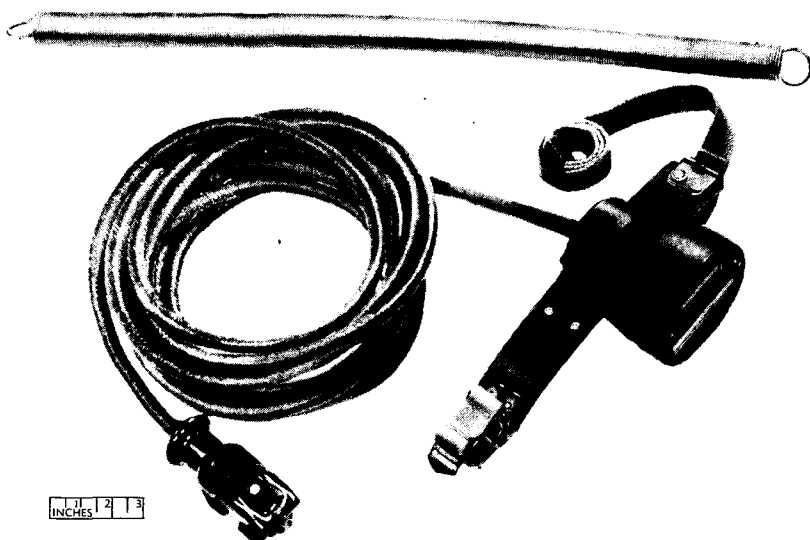
b. The accessories provided with each weapon are listed below; those issued to the battery mechanic are listed in section XII, Special Organizational Tools and Equipment. If it becomes necessary to replace a broken or missing accessory, this list should be checked with SNL D-24, which is the authority for requisitioning.

Part One — Introduction

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR GUN, 155-MM, M1A2			
BELT, primer, M8		D7225490	—
BOOK, Arty. Gun, O.O. Form 5825 (blank)	12	—	To keep records.
BRUSH, bore, M13.....	12	C73734	Used with cleaning staff to clean and oil bore or gun (see par. 9.)
COVER, bore brush	13	C76513	—
COVER, breech end, M211.....		D40786	—
COVER, gun book, M539.....		C7228906	—
COVER, muzzle, M314.....		D40555	—
GAGE, headspace, firing mechanism, M1		41-G-200-700	Check headspace between firing mechanism and obturator spindle plug.
HEAD, rammer, loading.....	12	B108585	—
LANYARD, firing, 6 ft., M12....	13	B6780	To fire gun.
RAMMER, cleaning and unloading, M7	12	C57112	—
REAMER, carb-S., hand, primer seat cleaning, spiral, flute, w/wood handle, diam. small end 0.321 in., diam. large end 0.362 in., length over-all 7 in....	12	41-R-501-80	—
REFLECTOR, breech	13	C72863	—
REFLECTOR, muzzle	13	C66028	—
SIGHT, bore, breech		41-S-3636-220	—
SIGHT, bore, muzzle		41-S-3646-100	—
STAFF-SECTION (46½ in. long)	12	C55199	Used with bore brush, rammer, and rammer head.
TARGET, testing, 155-mm gun carriage M1, size 36 x 26 in....		1-T-283-375	—
TECHNICAL MANUAL 9-350		—	—
TOOL, cleaning, vent, drill bit type, diam. of bit 0.206 in....	12	41-T-3081-120	To clean obturator spindle vent.
TRAY, loading, M1.....	14	D36840	—
WRENCH, open end, stght., hdl., stght. opng. sgle-hd., w/pick on other end, size of opng. 2.05 in.....	12	41-W-1596-50	For interchanging and tightening fuze. Also used to set fuze to "DELAY" or "SUPERQUICK."
WRENCH, spanner, face, Ordnance design, type 2-pin, c. to c.-of pins 0.875 in.	12	41-W-3248-251	To disassemble firing mechanism.
WRENCH, tubular, pronged, sgle. end, O.D. 1⅜ in., length 2.25 in., No. of prongs 2.....	12	41-W-3736-150	For crankshaft nut.

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part One — Introduction



RA PD 80191

Figure 15 — Blackout Light-system

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR CARRIAGE, GUN, 155-MM, M1 AND M1A1			
BAR, crow, pinch-point, size $\frac{3}{4}$ x 30 in.	16	41-B-168	—
BAR, crow, pinch-pt., diam. of stock $1\frac{1}{4}$ in., length 60 in.....	16	41-B-175	—
BUCKET, metal, galv., heavy weight, cap. 14 qts., gage 14....	16	42-B-25520	—
CHEST, tool, empty, metal, height $11\frac{1}{8}$ in., length $13\frac{3}{4}$ in., width $28\frac{7}{8}$ in.....		41-C-857-335	—
COVER, bogie lifting screw, M507	18	D33759	—
COVER, cam, elevating brake, M514	18	C76352	—
COVER, (over-all), M102.....		D91382	—
EXTRACTOR, cotter pin, lgth. 7 in.	19	41-E-525	—
FILLER, cradle guide.....		D39001	Clamped in cradle guides when gun is retracted to prevent dirt from accumulating on cradle guide when traveling.
GUIDE, War Dept., lubr., No. 10		—	

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part One — Introduction

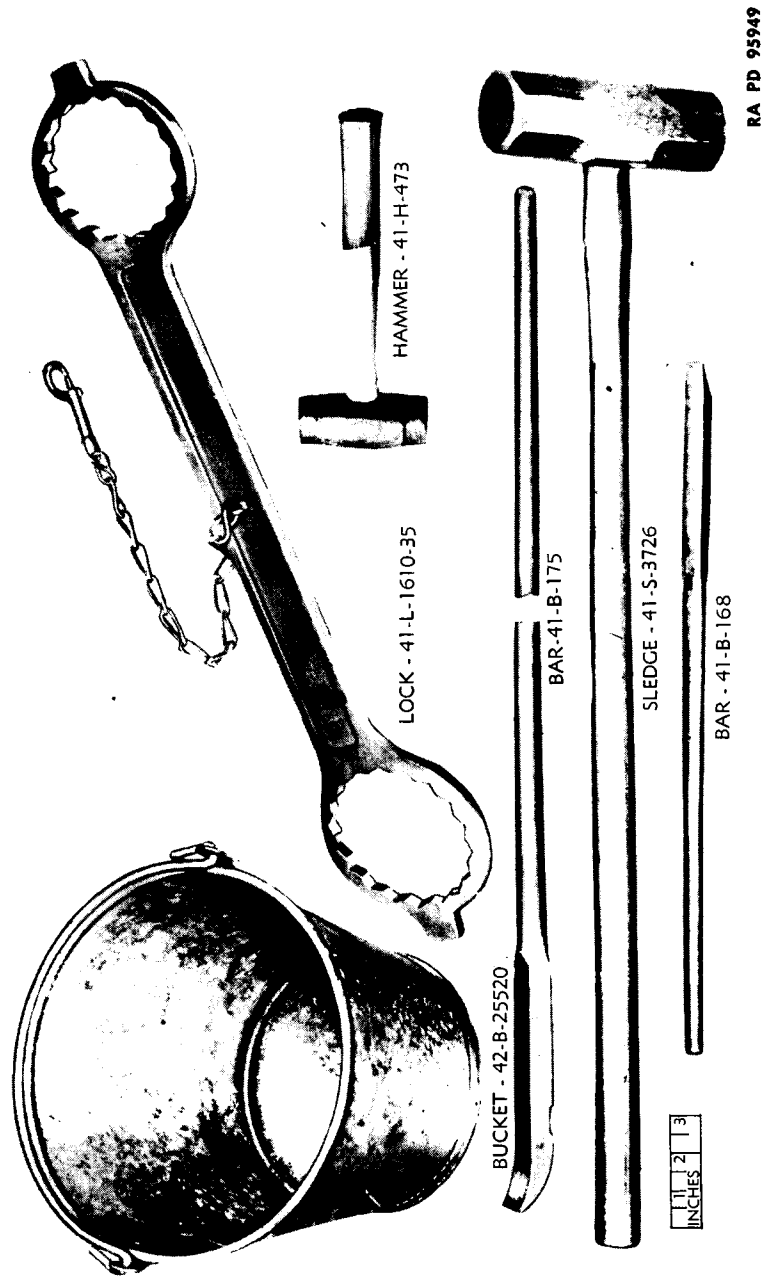
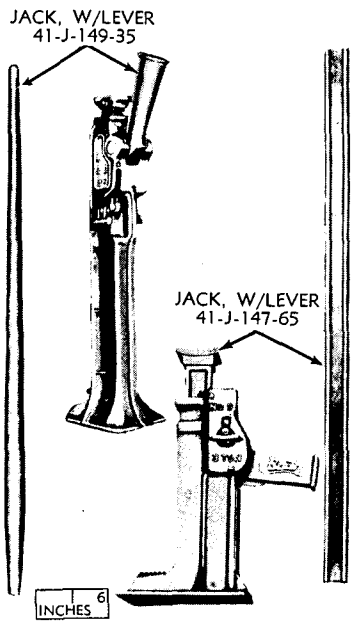


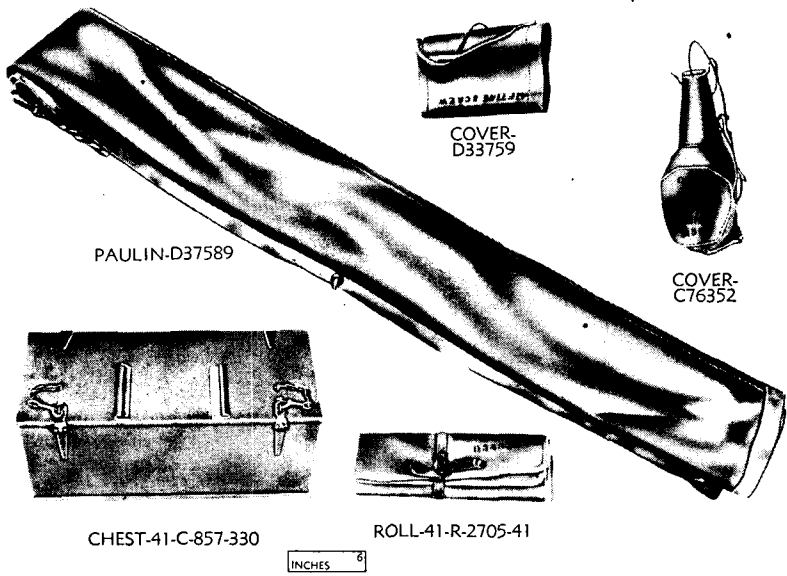
Figure 16 — Tools and Accessories

Part One — Introduction



RA PD 57526

Figure 17 — Jacks, w/Levers



RA PD 103169

Figure 18 — Tools and Accessories

Part One — Introduction

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR CARRIAGE, GUN, 155-MM, M1, AND M1A1 (Contd.)			
GUN, lubr., push-type, hydraulic, 7 oz. cap., M2, complete (Artillery)	21	41-G-1344	—
OR			
GUN, lubr., hand operating, push type, M1, complete w/extension (41-E-485).....		41-G-1341-8	—
HAMMER, machs., ball peen, weight 1¼ lb.	20	41-H-524	—
HOIST, chain, rtc., lever type, cap. 1½ to 3 tons.....		41-H-2115	To retract the gun from and restore it to traveling position.
JACK, rtc. lever, automatic, cap 15 tons, closed height 35 in., rise 24½ in.....	17	41-J-149-35	—
JACK, rtc. lever, automatic, 3 tons, w/lever	17	41-J-147-65	—
LIGHT - SYSTEM, blackout, 6-8 v., 45 ft. cable, compete..	15	C90802	Placed around muzzle end of gun when traveling.
LOCK, bogie lifting screw.....	16	41-L-1610-35	To prevent the two bogie lifting screws from turning during travel.
OILER, S., stght. spout, push bottom, cap. ½ pt., length of spout 4 in.....	21	13-O-1503	—
PAULIN, canvas, size 12 x 12 ft.	18	D37589	—
PLIERS, side cutting, flat nose, length over-all 8 in.....	20	41-P-1977	—
ROLL, tool, canvas, empty, M4, size 26 x 30 in.....	20	41-R-2705-5	—
SCREWDRIVER, common, normal duty, sgle. grip, length of blade 6 in., width of blade 5/16 in.	20	41-W-1104	—
SCREWDRIVER, jewelers', wood handle, length of blade 2 in., width of blade 0.125 in...	20	41-S-1339	—
SCREWDRIVER, machs., extra heavy duty, wood insert handle, length of blade 5 in., width of blade ½ in.....	20	41-S-1385	—
SLEDGE, blacksmiths', dble. faced, weight 10 lb.....	16	41-S-3726	—
STRAP, webbing, width 1¼, length 64 in.....		QADX1DK	—
WRENCH, adj., crescent, type, sgle-end., length 8 in., jaw opng. 15/16 in.....		41-W-486	—
WRENCH, adj., crescent type, sgle-end., length 15 in., jaw opng. 111/16 in.....		41-W-489	—

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part One — Introduction

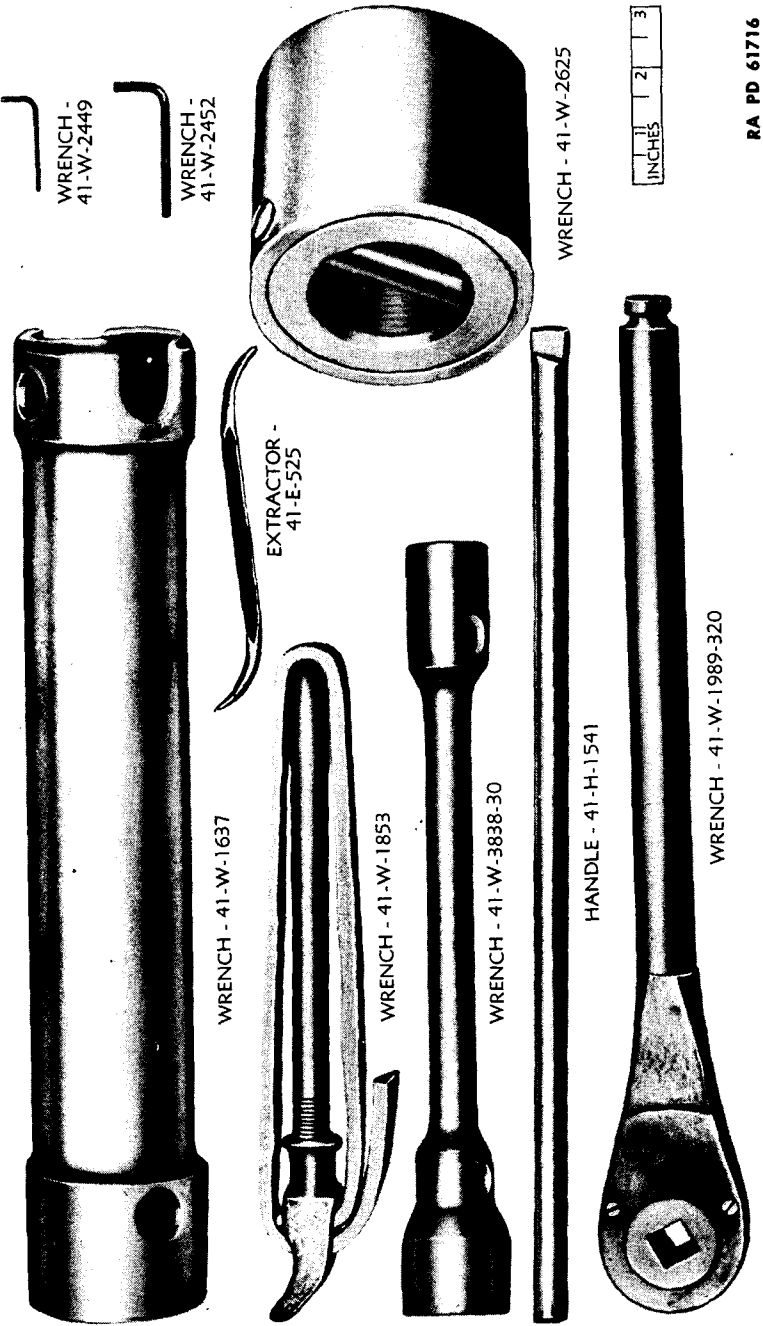


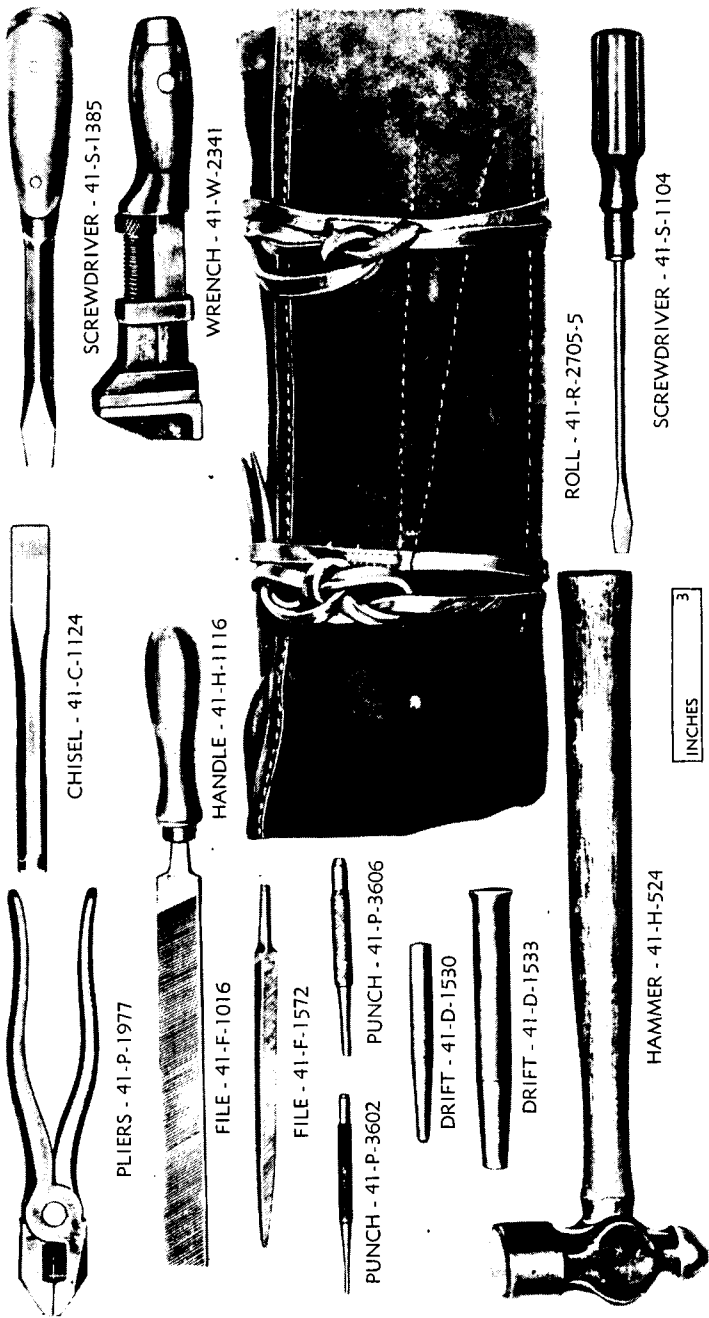
Figure 19 — Tools and Accessories

Part One — Introduction

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR CARRIAGE, GUN, 155-MM, M1, AND M1A1 (Contd.)			
WRENCH, pintle bolt nut, hex. opng. $2\frac{13}{16}$ in.....	19	41-W-1637	—
WRENCH, rtc., reversible, off- set handle, hex., opng., size of opng. 4 in., length $62\frac{1}{2}$ in.....	23	41-W-1989-600	Two of these wrenches are provided to turn the bogie lifting screws to raise or lower the bottom carriage. They are secured by clips to the outside of the trails. Two spring-loaded dogs underneath the cover are actuated by a lever. A latch on the outside of the cover operates the lever to engage one of the dogs with a geared nut, thus changing the direction of rotation. Periodically remove the cover and clean any dirt which may have accumulated in the interior of the wrench.
WRENCH, rtc., reversible, sq- opng., size $\frac{3}{4}$ in., length 18 in. (Composed of: 1 GEAR, wrench, rtc., re- versible, sq-opng., flat type, size $\frac{3}{4}$ in. (41-G- 586-40) 1 HANDLE, wrench, rtc., reversible, length 18 in. (41-H-1548-400))	19	41-W-1989-320	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam., $\frac{3}{32}$ in., screw size set No. 10, cap No. 5-6.....	19	41-W-2449	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam. $\frac{1}{8}$ in., screw size No. $\frac{1}{4}$ in., cap No. 8, socket No. 10 flat		41-W-2450	—
WRENCH, set or cap screw (hollow head), hex., plug type, regular short arm series, hex. diam. $\frac{3}{16}$ in., screw size set $\frac{3}{8}$ in., cap $\frac{1}{4}$ in.	19	41-W-2452	—

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part One — Introduction



RA PD 22832

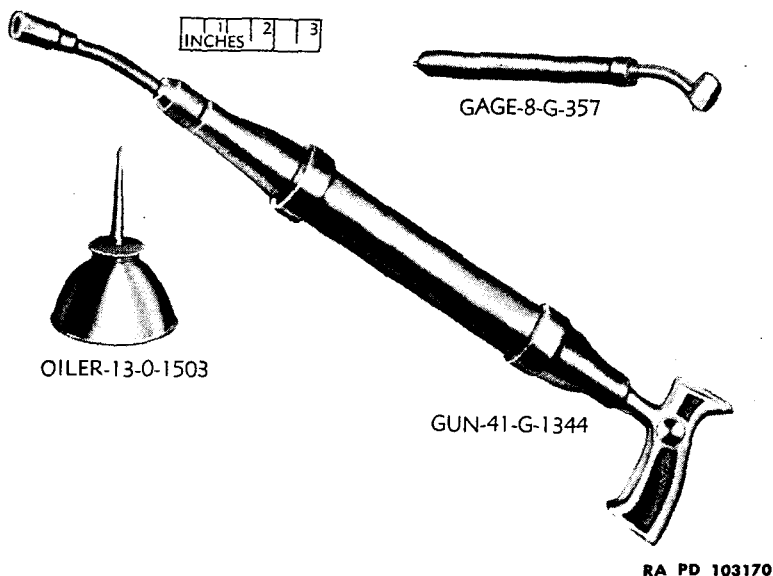
Figure 20 — Tools and Accessories

Part One — Introduction

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR CARRIAGE, GUN, 155-MM, M1, AND M1A1 (Contd.)			
WRENCH, socket, recoil rod nut, hex. opng., size $4\frac{1}{2}$ in.....	19	41-W-2625	—
WRENCH, wheel bearing nut, dble.-end., octagon opngs., size of opngs. $3\frac{3}{16}$ in. and $3\frac{7}{8}$ in.		41-W-2612-25	To adjust wheel bearing outer jam nuts and the nut and dowel assem- blies.
FOR MOUNT, GUN, 155-MM, M13			
ADAPTER, S. (plug), oil filling, recoil mechanism, diam. hex. head $\frac{3}{4}$ in., over-all length $1\frac{11}{16}$ in.	70	41-A-26-500	—
BAR, crow, pinch point, size $\frac{3}{4}$ x 30 in.	16	41-B-168	—
CAP, oil screw filler (gun).....	70	41-C-395-625	—
CHEST, oil pump M16, w/basic contents		—	For filling recoil system.
(Composed of:			
1 CHEST, oil pump, wood, S. reinforced, w/o con- tents, M16 (41-C-738- 550)	70		
1 FUNNEL, copper, w/o strainer, cap. $\frac{1}{4}$ pt. (41-F-3580)	70		
1 HOSE, gasoline and oil, non-metallic, high temp. resisting complete w/cou- plings, length 120 in., ends threaded $\frac{1}{4}$ in., ends threaded $\frac{1}{4}$ in.-18NPT and $\frac{1}{8}$ -27NPT (33-H- 535)	70		
1 PUMP, hydraulic, oil, M3 (11-P-576-300).....	70		
1 RULE S., flexible, length 30 cm, grad. one edge mm, other 64ths (41-R- 2909)	70		
1 WRENCH, engrs., angle 15° , dble. head, open end, normal duty, alloy- S., size of opng. $\frac{3}{4}$ x $1\frac{3}{16}$ in. (41-W-1012))	70		

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part One — Introduction



RA PD 103170

Figure 21 — Tools and Accessories

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR MOUNT, GUN, 155-MM. M13 (Contd.)			
COVER, cam, elevating brake, M514		C76352	—
COVER, gun, over-all, M102 complete		D91382	—
CYLINDER, gas filled, com- pressed gas, M1, O.D. $\frac{9}{16}$ in., length $56\frac{3}{16}$ in.		51-C-2255	For adjusting equilibra- tor pressure.
GUIDE, War Dept., lubr., No. 10		—	—
GUN, lubr., push type, hydrau- lic, 7 oz. cap., M2, complete (Artillery)	21	41-G-1344	—
OR			
GUN, lubr., hand operating, push type, M1, complete w/extension (41-E-485)		41-G-1341-8	—
OILER, S., stght. spout, push bottom, cap. $\frac{1}{8}$ pt., length of spout 4 in.	21	13-O-1503	—
RELEASE, gage, pressure, fill- ing and drain valve.	70	45-R-3650	—

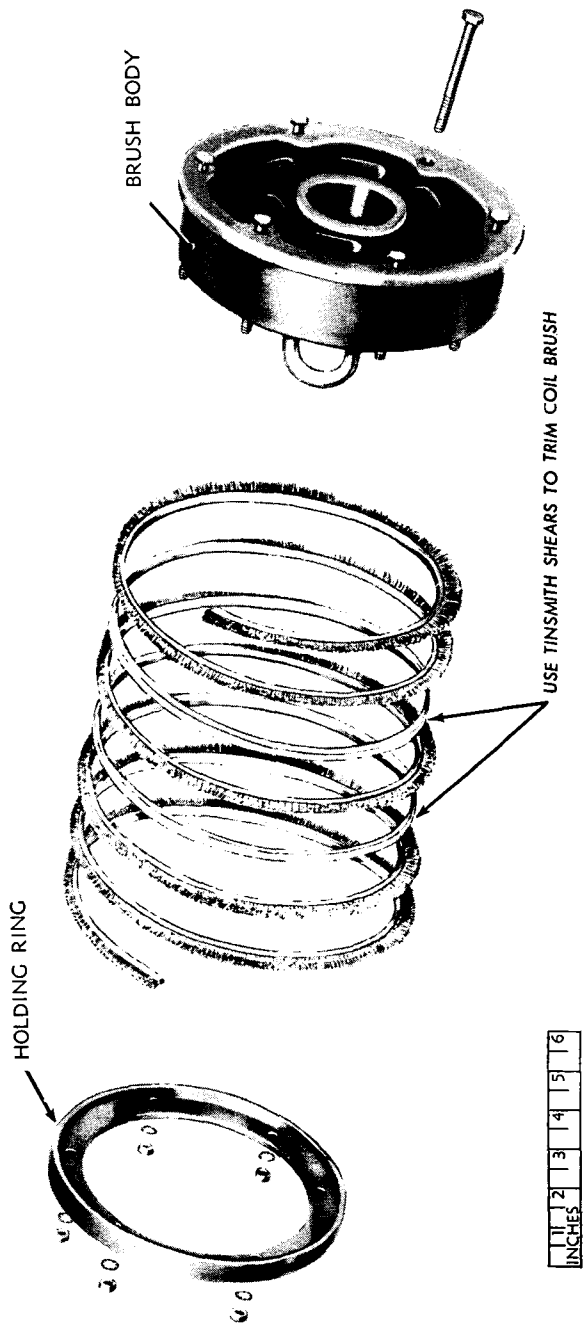
*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part One — Introduction

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR MOUNT, GUN, 155-MM, M13 (Contd.)			
ROLL, tool, canvas, empty, M4, size 26 x 30 in.....	20	41-R-2705-5	—
SCREWDRIVER, common, normal duty, sgle. grip, length of blade 6 in., width of blade $\frac{5}{16}$ in.	20	41-S-1104	—
SCREWDRIVER, machs., ex- tra heavy duty, wood insert handle, length of blade 5 in., width of blade $\frac{1}{2}$ in.....	20	41-S-1385	—
WRENCH, adj., crescent type, sgle-end., length 8 in. jaw opng. $\frac{15}{16}$ in.		41-W-486	—
WRENCH, adj., crescent type, sgle-end., length 15 in., jaw opng. $1\frac{11}{16}$ in.		41-W-489	—
WRENCH, rtc., reversible, sq- opng., size $1\frac{1}{8}$ in., length 24 in.		41-W-1989-440	—
(Composed of:			
1 GEAR, wrench, rtc., re- versible, sq-opng., flat type (41-G-586-160)			
1 HANDLE, wrench, rtc., reversible, length 24 in. (41-H-1548-600))			
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam. $\frac{3}{32}$ in., screw size set No. 10, screw size cap No. 5 and No. 6.....	19	41-W-2449	—
WRENCH, set or cap screw (hollow head), hex., plug type, regular short arm series, hex. diam. $\frac{1}{8}$ in., screw size set $\frac{1}{4}$ in., cap No. 8 socket No. 10 flat		41-W-2450	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex., diam. $\frac{3}{16}$ in., screw size set $\frac{3}{8}$ in., screw size cap $\frac{1}{4}$ in.	19	41-W-2452	—
WRENCH, socket, recoil rod nut, hex. opng., size $4\frac{1}{2}$ in.....	19	41-W-2625	—
FOR LIMBER, CARRIAGE, HEAVY, M2			
None authorized.			

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part One — Introduction



RA PD 103218

Figure 22 — Modification of Bore Brush M13

Part One — Introduction

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR LIMBER, CARRIAGE, HEAVY, M5			
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of opngs. 1 and 1 $\frac{1}{16}$ in.....		41-W-1024-2	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, carb-S., size of opngs. 1 $\frac{1}{8}$ and 1 $\frac{1}{2}$ in.....		41-W-1065-40	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, carb-S., size of opngs. 1 $\frac{11}{16}$ and 1 $\frac{7}{8}$ in.....		41-W-1065-220	—
WRENCH, tubular, dbble. end, hex opngs. 3 $\frac{1}{16}$ and 3 $\frac{3}{16}$ in., length 9 in.		41-W-3727-43	—
FOR PLATFORM, FIRING, 155-MM GUN, M1			
CHEST, tool, empty, metal, Ordnance design, w/o parti- tions, inside height, in. 11 $\frac{1}{16}$, inside width, in. 13 $\frac{3}{4}$, inside length, in. 28 $\frac{7}{8}$, material S...	18	41-C-857-330	—
FILE, A.S., mill, type A, cut bast., length point to shoulder 10 in.	18	41-F-1157	—
FILE, A.S., three sq., cut bast., length point to shoulder 8 in...		41-F-1553	—
HANDLE, sledge, length 36 in...		41-H-1489	—
PLIERS, side-cutt., flat-nose, over-all, 8 in.....	20	41-P-1977	—
SCREWDRIVER, common, normal duty, sgble. grip, length of blade 6 in., width of blade 5 $\frac{1}{16}$ in.	20	41-S-1104	—
SLEDGE, blacksmiths', double- faced, weight 10 lbs.....	16	41-S-3726	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of openings 7 $\frac{1}{8}$ and 1 in.....		41-W-1019-50	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of openings 1 $\frac{1}{8}$ and 1 $\frac{5}{16}$ in.....		41-W-1028	—
WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of openings 1 $\frac{1}{2}$ and 1 $\frac{5}{8}$ in.....		41-W-1036-5	—
WRENCH, engrs., angle 15°, sgble. head, open end, normal duty, alloy-S., size of openings 1 $\frac{7}{8}$ in.		41-W-1314	—

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part One — Introduction



RA PD 86553

Figure 23 — Bogie Lifting Screw Wrench

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
FOR PLATFORM, FIRING, 155-MM GUN, M1 (Contd.)			
WRENCH, engrs., angle 15°, sgle. head, open end, normal duty, carb-S., size of opening 3¾ in.		41-W-1430	—
WRENCH, screw, monkey, metal handle, jaw opng. size 12 in.		41-W-2353	—

9. MODIFICATION OF BORE BRUSH M13. The cleaning characteristics and length of service of the bore brush M13 can be improved by slight modification.

- a. Remove nuts and lock washers from the front face of bore brush, and the holding ring from the brush body; then remove the coiled brush insert.
- b. Separate the coil of the brush and, using a pair of tinsmith shears, trim the bristles off level with the channel on two full coils, one on each side of the middle coil, as shown in figure 22.
- c. The steel channels grip for bristles must not be cut or modified.
- d. Reassemble the parts in reverse order of disassembly.

*When the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

PART TWO — OPERATING INSTRUCTIONS

Section IV

GENERAL

10. SCOPE. Part Two contains information for the guidance of the personnel responsible for the operation of this equipment. It contains information on the operation of the equipment with the description and location of the controls and instruments.

Section V

SERVICE UPON RECEIPT OF MATERIEL

11. GENERAL.

a. Upon the receipt of new or used materiel, it is the responsibility of the officer in charge to ascertain whether or not it is complete and in sound operating condition. A record should be made of any missing parts and of any malfunctions, and any such conditions should be corrected as quickly as possible.

b. Attention should be given to small and minor parts, as these are the more likely to become lost and may seriously affect the proper functioning of the materiel.

c. The materiel should be prepared for service in accordance with instructions given in paragraphs 12 and 13.

12. NEW EQUIPMENT.

a. The following steps are suggested as a guide which can be followed to determine the serviceability of the materiel:

- (1) Check the gun book for proper entries as outlined in section I.
- (2) Remove all corrosion-preventive from the weapon.
- (3) Inspect all operating parts for smoothness of operation.
- (4) Check the gun and carriage for general appearance and condition of paint; make certain all lubrication fittings are properly painted (par. 40). Review part three, for detailed inspection and adjustment procedure.
- (5) Disassemble and clean breech and firing mechanisms (sections XVII, XVIII, and XIX).
- (6) The materiel should be lubricated in accordance with War Department Lubrication Order, section XIII.

Part Two — Operating Instructions

(7) Check spare parts and accessories with the OSP&E of SNL D-24.

(8) Inspect tools and accessories, section III.

13. USED EQUIPMENT

a. Repeat the steps outlined in paragraph 12.

b. When checking the gun book as outlined in section I, be sure that all War Department Modification Work Orders have been taken care of. If not, proper procedure should be followed to have this done.

c. Check all the materiel for signs of excessive wear, damage, and missing parts (par. 11).

Section VI

CONTROLS AND INSTRUMENTS

14. **GENERAL.** The controls and instruments used to operate the gun throughout the cycle of loading, firing, and reloading for continuous firing, are located and described in this section. For location and description of sighting controls and instruments used in laying the gun see section XXVIII.

15. CONTROLS.

a. **Elevating controls.**

(1) **ELEVATING MECHANISM CLUTCH LEVER.** The elevating mechanism clutch lever is located on the right side of the top carriage adjacent to the elevating handwheel (fig. 24). The purpose of this lever is to control the elevating brake which locks the gun at any desired angle of elevation. To release the elevating brake, depress the elevating mechanism clutch lever. To set the brake, raise the lever.

(2) **ELEVATING HANDWHEEL.** The elevating handwheel located on the right side of the top carriage (fig. 24) controls the movement of the gun throughout its range of elevation and depression after the elevating mechanism clutch lever has been released. To elevate the gun, depress the elevating mechanism clutch lever and rotate the elevating handwheel clockwise. To depress, rotate the elevating handwheel counterclockwise.

b. **Traversing controls.**

(1) **TRAVERSING BRAKE HANDLE.** The traversing brake handle is located on the traversing handwheel shaft at the left side of the top carriage (fig. 25). This handle locks the traversing handwheel shaft, preventing rotation of the traversing handwheel and the traversing of the weapon. Rotating the traversing handwheel counterclockwise releases the traversing mechanism.

Part Two — Operating Instructions

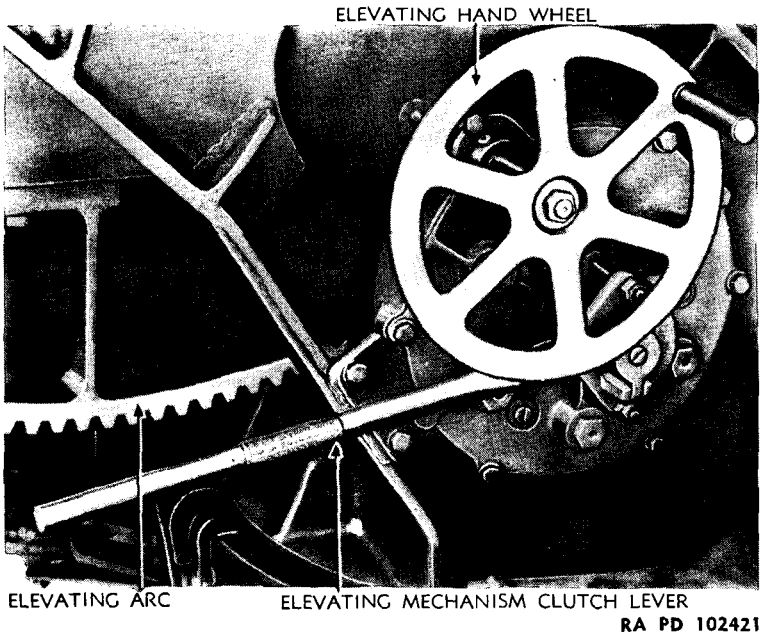


Figure 24 — Elevating Controls

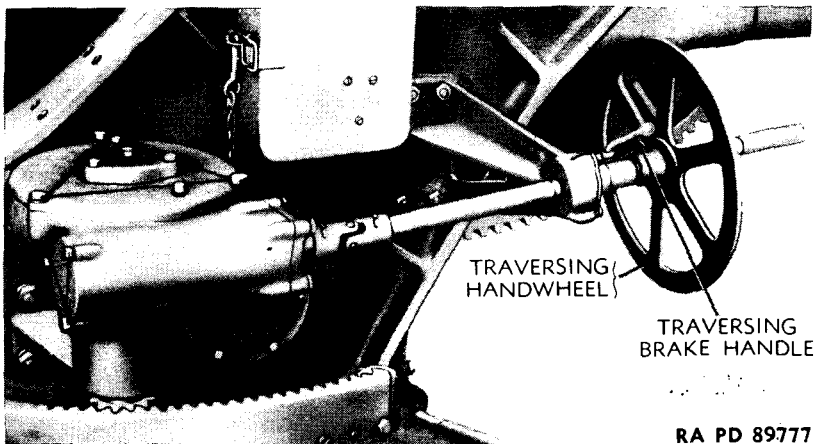


Figure 25 — Traversing Controls

Part Two — Operating Instructions

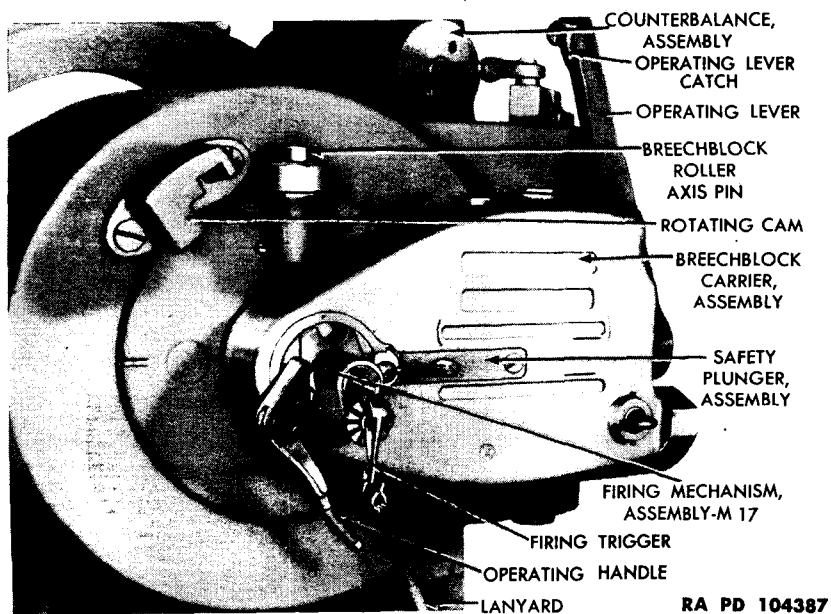


Figure 26 — Breech and Firing Mechanism Controls — Breech Closed

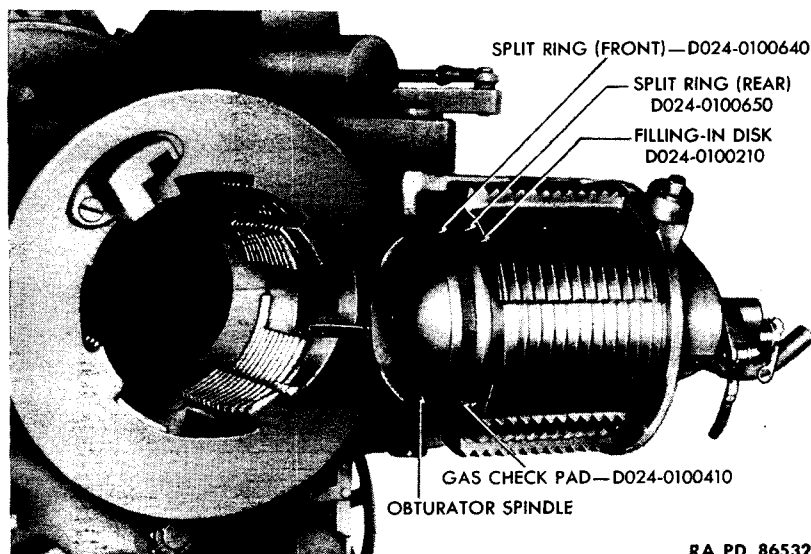


Figure 27 — Breech and Firing Mechanism Controls — Breech Open

Part Two — Operating Instructions

RA PD 86559

- A—ARCH AXLE
- B—CRADLE LOCK
- C—TORQUE ROD
- D—BOGIE LIFTING SCREW LOCK
- E—BOGIE LIFTING SCREW
- F—HAND BRAKE LEVER
- G—BRAKE CHAMBER
- H—PINTLE

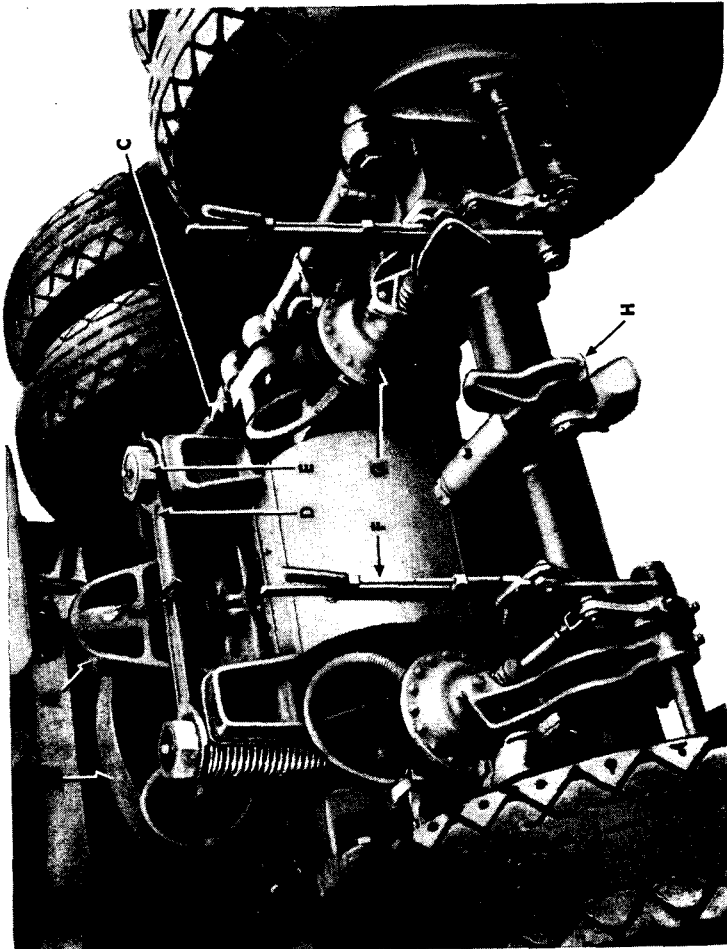


Figure 28 — Bogie in Traveling Position

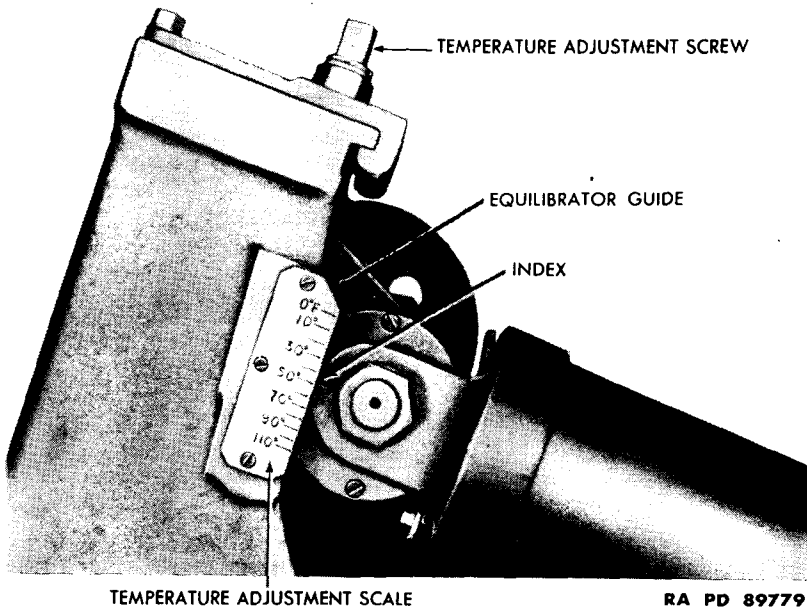
Part Two — Operating Instructions

Figure 29 — Temperature Adjustment Scale

(2) **TRAVERSING HANDWHEEL.** The traversing handwheel located on the left side of the top carriage (fig. 25) controls the movement of the gun throughout its range of traverse after the traversing brake has been released. To traverse the gun release the traversing brake handle and rotate the traversing handwheel clockwise at right traverse and counterclockwise for left traverse.

c. **Breech operating controls.** The purpose of the breech operating lever, attached at the right side of the breechblock carrier, (figs. 26 and 27) is to provide a means to open or close the breech. This lever can be operated only after the firing mechanism M1 has been removed or the firing lock M17 opened (see subpar. d (1) and (4), below). This is done by grasping the lever, pushing the operating lever catch (fig. 26) down, and pulling and swinging the operating lever to the right.

d. **Firing controls.** (see par. 3 f).

(1) **OPERATING HANDLE.** The firing lock M17 is opened for loading and closed for firing by means of the operating handle (fig. 26).

(2) **FIRING TRIGGER.** The firing lock M17 fires the gun manually by means of the lanyard-operated firing trigger (fig. 26).

Part Two — Operating Instructions

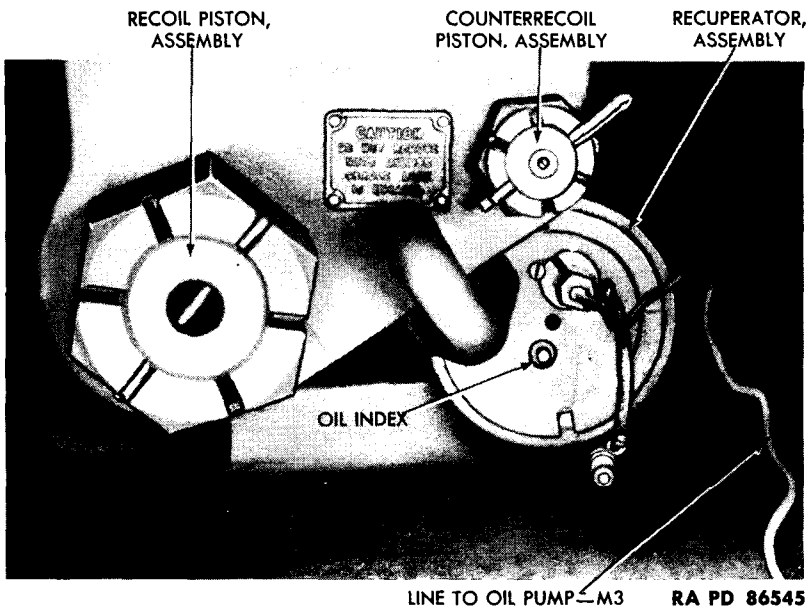


Figure 30 — Oil Index

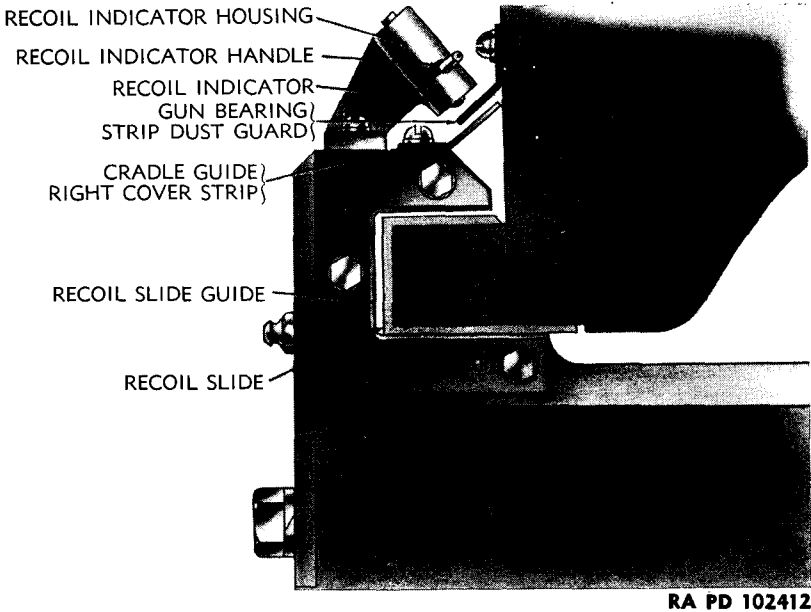
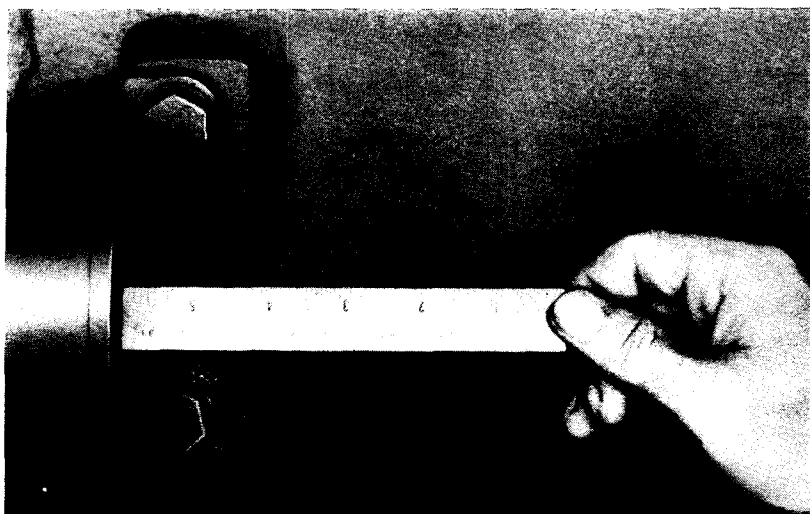


Figure 31 — Recoil Indicator

Part Two — Operating Instructions



RA PD 86544

Figure 32 — Replenisher Piston

(3) **PERCUSSION HAMMER.** The firing mechanism M1 fires the gun manually by means of the lanyard-operated percussion hammer (fig. 50).

(4) **FIRING MECHANISM HANDLE.** The firing mechanism M1 is inserted and locked in the firing mechanism receiver housing and unlocked and withdrawn by means of the firing mechanism handle (fig. 49).

(5) **LANYARD.** The purpose of the lanyard is to provide a means to fire the gun from a distance, sufficient to give the gunner protection from the recoiling parts.

(a) The lanyard is attached to the trigger on the firing lock M17 (fig. 26).

(b) The lanyard is attached to the percussion hammer on the firing mechanism M1 (fig. 50).

e. Brake mechanism controls.

(1) **AIR BRAKES.** The air brakes on all bogie wheels are actuated from the prime mover.

(2) **HAND BRAKES.** Hand-operated levers (fig. 28) are to set the mechanical brakes on the bogie for parking.

16. INSTRUMENTS.

a. **Temperature adjustment scale.** The purpose of the temperature adjustment scale (fig. 29) is to provide an adjustment of equilibrator tension for various temperatures.

Part Two — Operating Instructions

b. **Oil index.** The oil index (fig. 30) indicates whether or not there is sufficient reserve oil in the recoil mechanism system to fire the gun without damage.

c. **Recoil indicator** The recoil indicator (fig. 31) is used to measure directly the length of recoil of the gun during firing.

d. **Replenisher piston.** The position of the replenisher piston indicates the amount of oil in the recoil cylinder and replenisher. A scale is provided to measure the position of the piston (fig. 32).

Section VII**OPERATION UNDER USUAL CONDITIONS****17. TO PLACE THE GUN AND HEAVY FIELD CARRIAGE IN FIRING POSITION.**

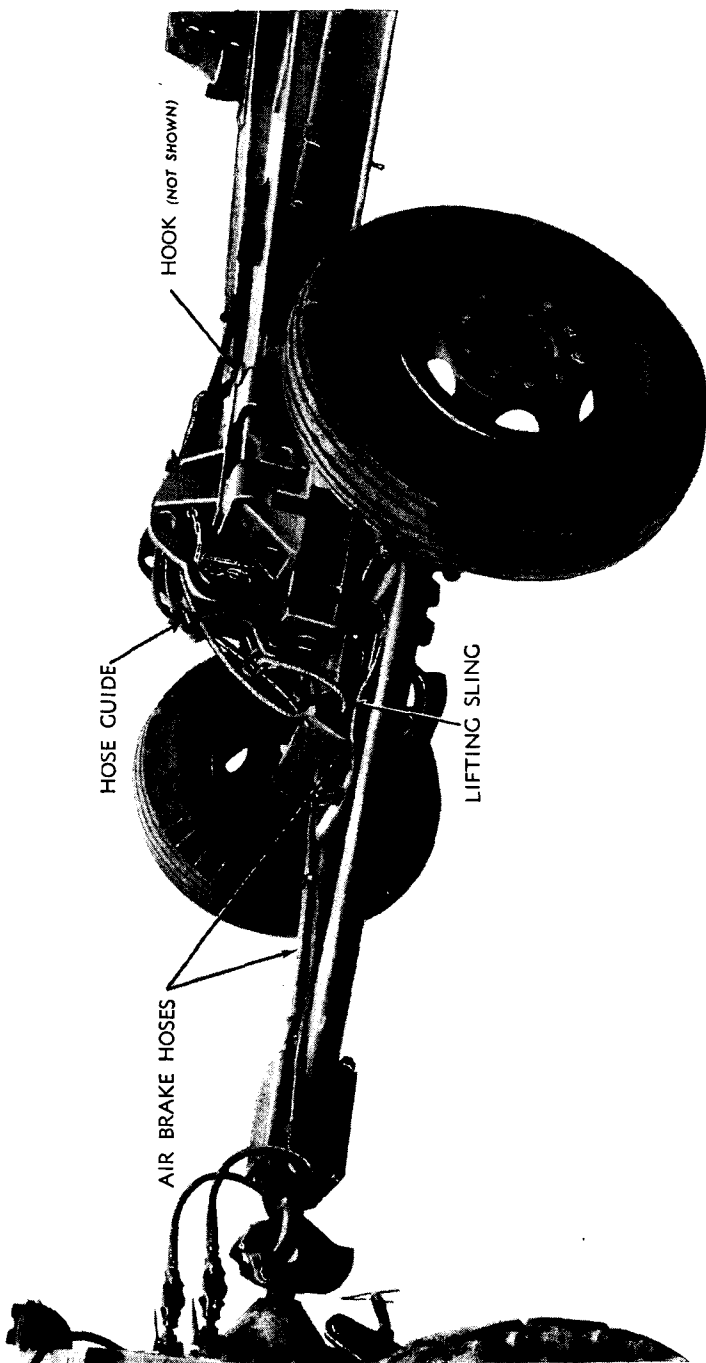
a. Shut off the air pressure at the prime mover. Unless it is desired to apply the brakes on the weapon automatically, the air tank on the carriage should be bled. Use hand brakes for parking. Disconnect the air hose of the limber from the prime mover and from the spade end of the trails. Lock the ends of the hose together at the front and rear of the limber. Place the dummy couplings on the ends of the air tubes on the trails. **NOTE:** *It is important to prevent dust, dirt, and other foreign matter from getting into the air lines since they cause malfunction of the brake mechanism.*

b. Remove the loading tray. When the carriage is in traveling position, the prescribed location for the loading tray is on top of the trails between the bottom carriage and the spades. The tray is inverted, and the front handles are placed in the recess formed by the front spades mounted on the trails. The tray is held in this position by the camouflage poles strapped to both trails over the handles of the loading tray.

c. Make certain that hand brakes on gun carriage are set, and that limber and prime mover are secured against undesired movement. **CAUTION:** *Using personnel should chock the limber and bogie wheels at the rear with wood blocks, sand bags, or other suitable and efficient blocking, whenever the materiel is disconnected from the prime mover and particularly when unlimbered on sloping terrain. The parking brakes alone should not always be relied on to hold the materiel stationary.* Stand clear of limber and trails. Remove the limber as follows:

(1) **REMOVING HEAVY CARRIAGE LIMBER M5** (figs. 33 to 37). Attach prime mover winch cable to limber lifting sling and take up cable until there is a slight strain on it. **CAUTION:** *It is important to have this sling sufficiently tight to hold up trails.* Remove cotter

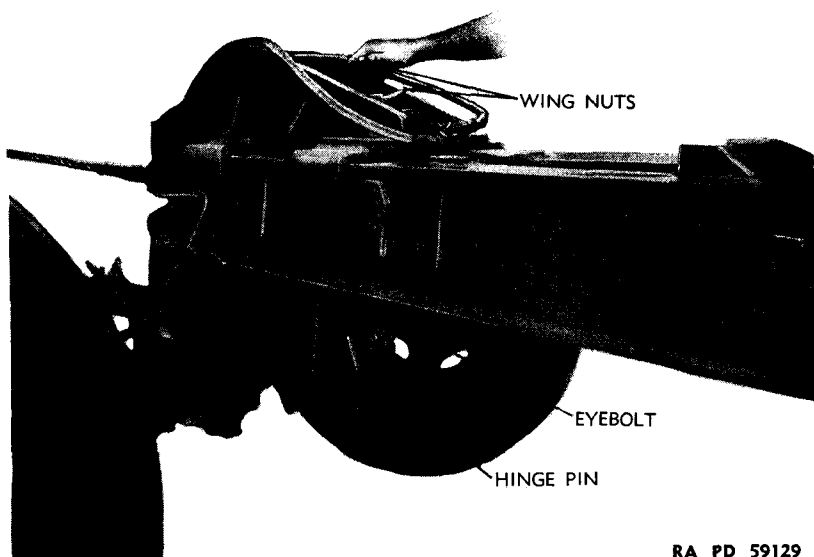
Part Two — Operating Instructions



RA PD 86529

Figure 33 — Carriage Limbered for Traveling (Heavy Carriage Limber M5)

Part Two — Operating Instructions



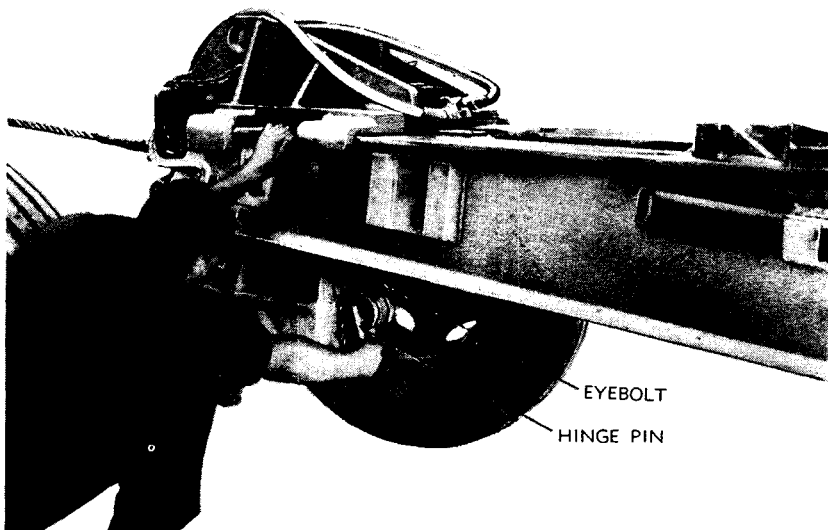
RA PD 59129

Figure 34 — Unlimbering the Trails — Step 1

pin, wing nuts, and eyebolt spacer piece from eyebolt (figs. 34 to 36). Remove eyebolt hinge pin and remove eyebolt from trail clamping bracket. Replace hinge pin. Pay out cable slowly from powered winch to allow a little slack. Use prime mover to pull limber forward slightly until limber lifting bracket assembly begins to rotate. Ease trails to the ground by means of winch. Remove bar wing nut from trail coupling pin and screw on bronze assembling nose. Remove trail coupling pin and pull limber clear of trails. Using powered winch, take in cable until the limber lifting bracket assembly is rotated to approximately vertical position. **CAUTION: Do not rotate past vertical.** Attach eyebolt to lifting bracket and to holding bracket on drawbar. One wing nut should be on each side of drawbar and eyebolt spacer seated in the groove on sling guide. This locks lifting bracket assembly in upright (traveling) position. Disconnect lifting sling from winch cable and wind up cable. Attach running end of lifting sling to rear hinge pin. Remove safety pins and nuts from trail clamp bolts, and remove trail clamping bracket. The T-bolt can be removed when trails are spread. All bolts and nuts should be assembled to trail clamping bracket after removal, to prevent loss.

(2) **REMOVING HEAVY CARRIAGE LIMBER M2.** Remove locking pin and lift off lock. Lock the drawbar to the limber lifting mechanism base by inserting the drawbar locking pin in the limber lifting

Part Two — Operating Instructions



RA PD 59134

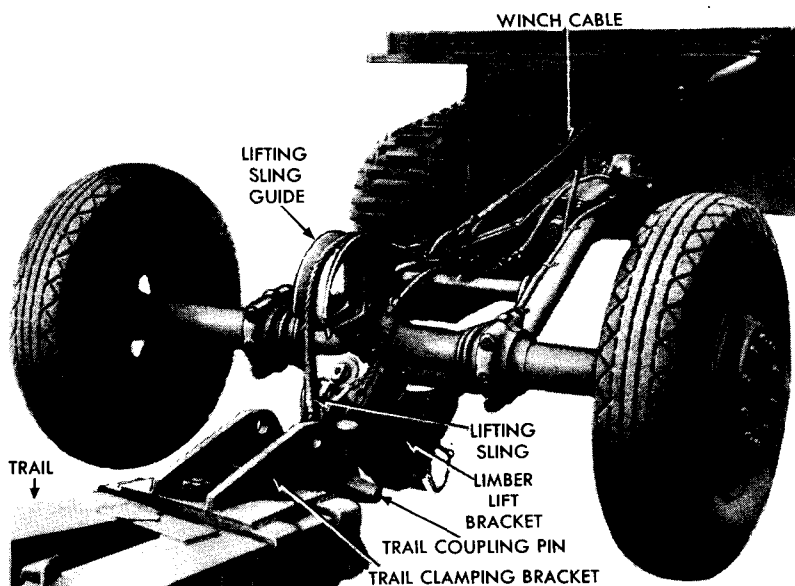
Figure 35 — Unlimbering the Trails — Step 2

mechanism tube. Remove pin and swing prop up under drawbar. Secure by placing snap in handle. Release the two locking pins on the limber which bear against the outside of the trails. Turn the limber lifting mechanism handle and lower the trails.

d. Remove the lock pin to disconnect the gun from the traveling lock.

e. Install the cable from the prime mover winch over and around the sheave on the top carriage, over the top of the breech ring (breechblock open), and attach it to the hook under the breech ring. A guard can be used over the breech ring. Operate the winch to pull the gun up to firing position. Secure the gun to the piston rods by installing the two piston rod nuts. **NOTE:** *It is necessary to allow a slight floating of the piston rod in the gun lug to prevent excessive wear on the stuffing boxes which might be caused by a slight irregularity in alignment of the recoil mechanism.* The nuts should be drawn tight and then backed off enough to allow approximately 0.005 inch end play between the gun and the piston rod socket. **CAUTION:** *The two piston rod nuts must always be installed before disengaging the cradle lock over the bogie.*

f. A modification work order provides that the sheave bracket assembly be replaced by a retracting eye. To place the gun in firing position, couple the hoist to the eye nearest the breech ring and to the yoke of the cradle, and jack the gun into battery position (fig. 38).

Part Two — Operating Instructions

RA PD 86560

Figure 36 — Trails Unlimbered

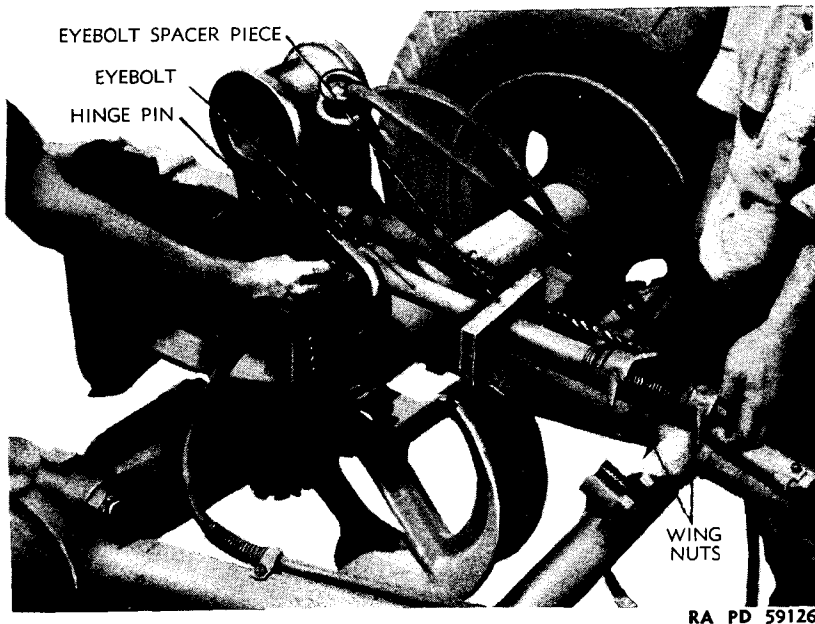
To place the gun in traveling position, couple the hoist to the eye nearest the muzzle and the yoke of the cradle, and jack the gun until it is properly engaged by the tube traveling lock.

g. Remove the traveling lock and spread the trails. Locate the holes for the rear spades and dig sufficiently deep to permit assembly of the spades to the trails.

h. Remove the bogie lifting screw lock (fig. 39). Remove bogie lifting screw covers (fig. 40). Remove the ends of the four wheel supporting cables from their brackets on the torque arms and attach them to the wheel supporting bolts on the bogie cross beam (fig. 41). Release the cradle lock from the cradle. Dig pits for front spades, then attach spades. Lower the carriage by operation of the bogie lifting screws with the bogie lifting screw wrenches (fig. 42), and continue operating the bogie lifting mechanism until the bogie wheels are raised completely off the ground. Operate both screws in unison to prevent cramping of the mechanism. Cables are attached to the brackets and axles to provide a support for the wheels when they are raised from the ground in firing position.

i. If the bearing strength of the soil is too low for more permanent emplacement of the materiel, embedded logs are used (railway ties may be used). These are placed behind the front and rear spades

Part Two — Operating Instructions



RA PD 59126

Figure 37 — Eyebolt in Carrying Position

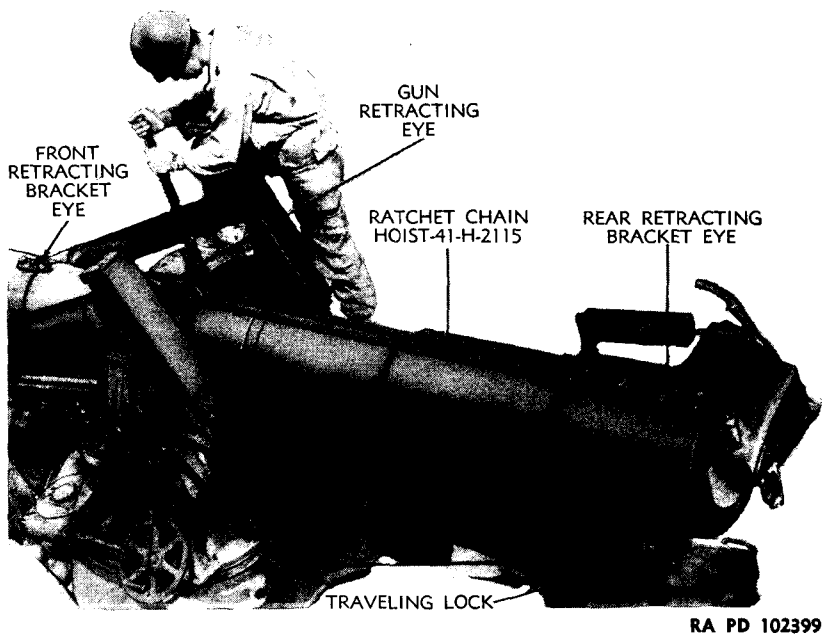
and dug in so as to distribute the force of recoil over a larger ground area and thus prevent movement of the weapon during firing.

- j. Remove covers from breech and muzzle.
- k. Install panoramic telescope in its mount.
- l. Release traversing mechanism by rotating the traversing brake handle counterclockwise.
- m. Place tools and accessories in proper position for firing.

18. TO PLACE THE GUN AND HEAVY FIELD CARRIAGE IN FIRING POSITION ON THE FIRING PLATFORM M1.

- a. For emplacing the firing platform, see paragraph 27.
- b. **Procedure.**

(1) The lower front spade supports must fit over the studs on the bolster, and permit the pivot blocks to be placed in position. Lower carriage on the bolster by raising bogie. During the operation of lowering the carriage, the gun and carriage may have to be maneuvered slightly to properly aline the bolster and bottom carriage. When bottom carriage is in position on the bolster, lower the trails from the limber. Place bolster clamps on bolster, and bolt in place (fig. 47).

Part Two — Operating Instructions

RA PD 102399

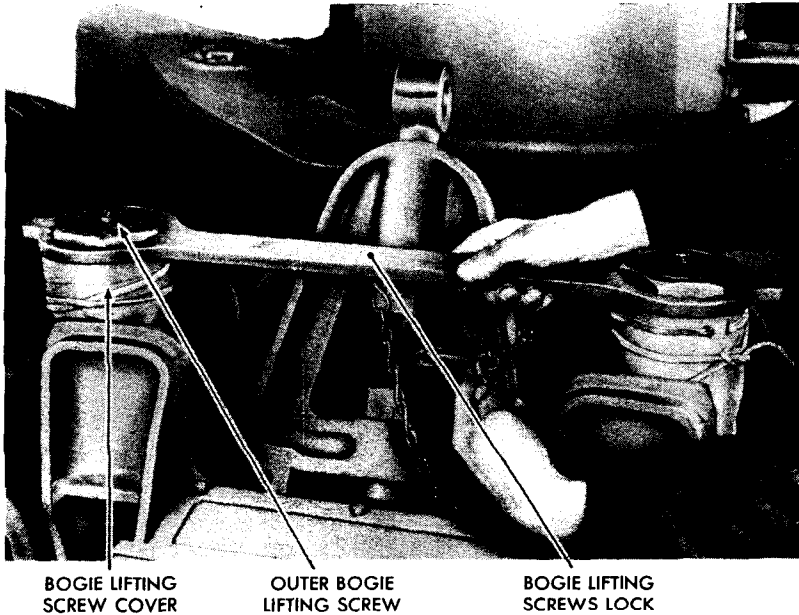
**Figure 38 — Pulling the Gun Forward Into Firing Position
With Ratchet Chain Hoist**

Drop yoke bar over bottom carriage and tighten locking nuts (fig. 46). Place pivot blocks in position in bottom front spade supports. Place bolster frame clamp over spade supports and lock with two nuts (fig. 46).

(2) Assemble remaining rail sections and attach remaining radial. Assemble trail clamps and rubbing plates on rail sectors with hooked bolt on outside of rail. Slide trail clamps into the trail spade seats. Fasten with trail spade key (fig. 57).

(3) Assemble trail brace, and hook the trail brace clevises over the top front spade supports. Tighten up clevis nuts, making sure that the support ends engage the trails properly. Assemble push bar assembly on end of trails. The push bar assemblies must have the clamp gib on the outside of the trails (fig. 57). Drive stakes around the outside of the rail sectors.

c. After the gun has been mounted and clamped on the bolster, further procedure to bring the weapon into firing position is the same as detailed in placing the heavy field carriage in firing position, paragraph 17.

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RA PD 86567

Figure 39 — Removing Bogie Lifting Screw Lock**19. TO PLACE THE GUN IN FIRING POSITION ON THE GUN MOUNT M13.**

a. Remove gun covers and store them out of the way in the proper place assigned for them; likewise, store the other equipment not required for operation of the weapon.

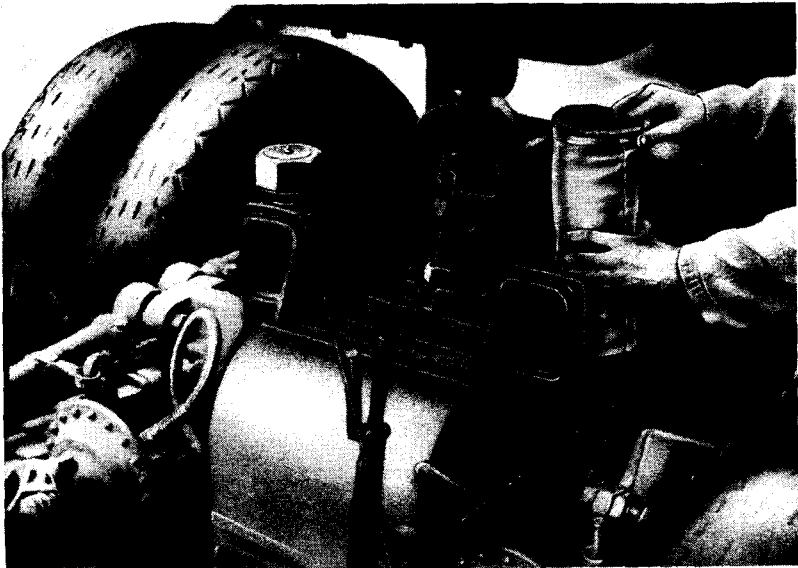
b. Unlock the tube front traveling lock (fig. 44) by loosening the nut which secures the upper half of the traveling lock, and unlock the rear traveling lock (fig. 43). Rotate the upper half up and off the tube; then elevate tube slightly in order to push traveling lock down in latched position on the hull.

c. Place spade in firing position. Free the top support arms of the spade assembly by removing the locking pins. Release winch ratchet arm and brake to lower spade to ground. Back up vehicle to force spade prongs into ground. When in its proper position, the spade must be flush with the ground and the spade stops seated against the hull. Apply vehicle steering brakes and lock in position.

20. LOADING THE GUN.

a. **Loading angle.** Bring the gun to approximately 15 degrees elevation.

b. **To open the breech.** Remove the firing mechanism M1 or open the firing lock M17. Push down on the breechblock operating

Part Two — Operating Instructions

BOGIE LIFTING OUTER SCREW

RA PD 102393

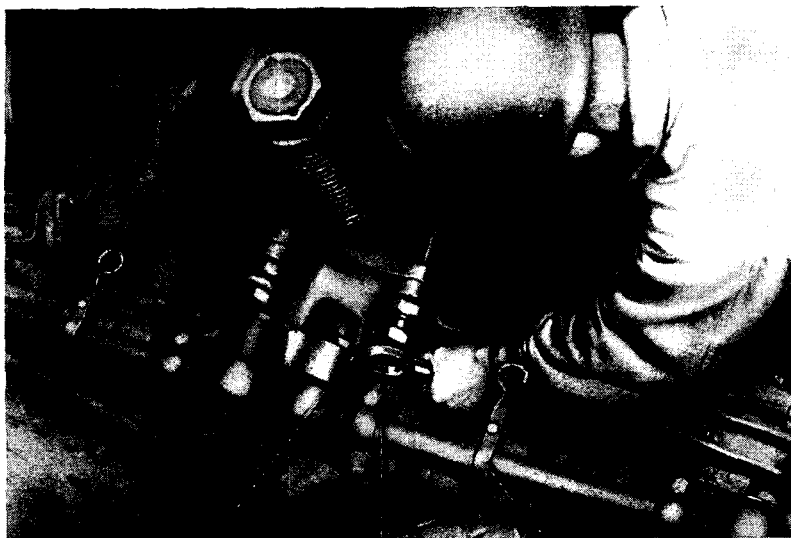
Figure 40 — Removing Bogie Lifting Screw Cover

lever catch, and pull the breechblock operating lever down to a horizontal position. Then swing the operating lever toward the muzzle of the gun.

c. **Powder chamber.** In between rounds of fire, immediately upon opening the breech, the powder chamber, including the forcing cone, should be swabbed out with the sponge. The bore should then be examined to make certain that there are no burnt fragments of powder bags or other objects remaining in the bore before reloading.

d. **Projectile.** A loading tray (fig. 48) is furnished both to provide for ease in loading and to protect the threads in the breech recess. The projectile is placed on the loading tray, the tray is lifted by the gun crew, and the front of the tray placed so that the brass projecting lug rests in a blank portion of the interrupted breech. The projectile is pushed clear of the loading tray by use of the rammer. Then the tray is removed and the projectile is rammed into position in the forcing cone. It is important that projectiles be rammed with a uniform force, since variations in the ramming force will cause slight variations in the range. It is also important that the rotating bands and bourrelet on a projectile are not damaged, as such damage is likely to cause erratic firing. To avoid damage to rotating bands the grommet should not be removed until the shell is being prepared for loading.

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CROSSBEAM TORQUE/
BRACKET BOLT}

WHEEL SUPPORTING CABLE

TORQUE ROD HOOK

RA PD 102389

Figure 41 — Attaching Wheel Supporting Cables to the Lugs on the Bogie

e. **Propelling charge.** It is not necessary to use the loading tray for placing the powder charge in the breech. Care must be taken to insure that the igniter end of the powder charge is located at the rear.

f. **To close the breech.** Pull the breech operating lever toward the breech and then push it to a vertical position.

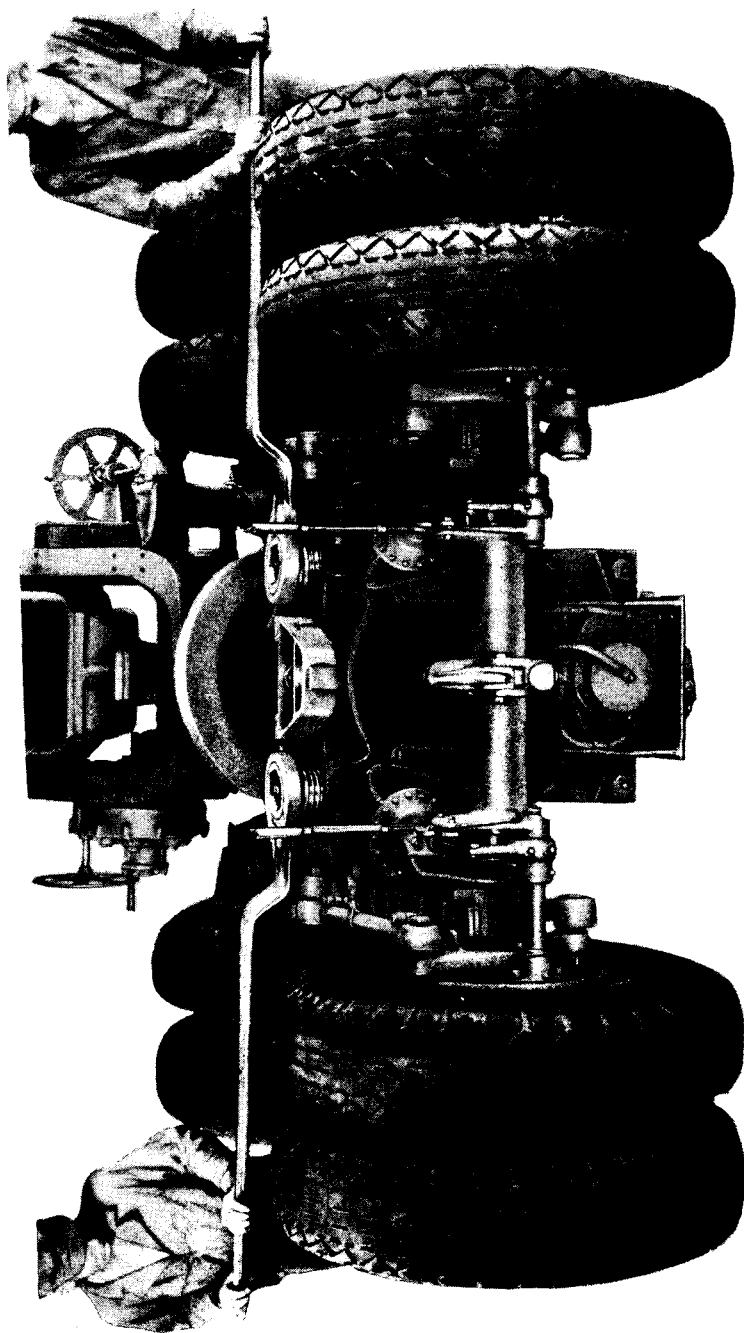
21. FIRING.

a. Release the elevating and traversing handwheel brakes and lay the gun in elevation and traverse. Operation of sighting and fire control equipment is covered in section XXVIII.

b. Insert primer. **NOTE:** *The breechblock must be closed before assembling the firing mechanism M1, and the firing mechanism M1 must be removed, or the firing lock M17 opened, before the breechblock can be opened.*

c. Make sure the firing mechanism is properly latched and then release hammer locking pin (when firing mechanism M1 is used).

d. On firing mechanism M1 installation, attach lanyard to hammer, keeping one hand between hammer and firing pin as an added safety precaution. On firing lock M17 installation, attach lanyard to the trigger and adjust trigger to position best suited for pulling

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RA PD 86546

Figure 42 — Lowering Bottom Carriage

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lanyard (figs. 26 and 86). This adjustment is made by pushing the longer arm of the trigger forward, which disengages the shorter arm from the notches in the selector. Then rotate the trigger to the desired location. The release of the lanyard permits the trigger to re-engage the firing hammer and the lock is ready for the next firing. To eject the primer, move the operating handle smartly to the left. This movement can best be obtained by striking the handle with the palm of the hand.

- e. Allow slack in lanyard.
- f. Pull lanyard sharply and with force, to fire with firing mechanism M1. Apply a steady pull to lanyard, to fire with firing lock M17.
- g. In case of a misfire, refer to paragraph 45.

22. TO UNLOAD. The piece will be unloaded only upon the specific orders and under the direct supervision of an officer. Remove the firing mechanism. Bring the gun to a horizontal position. Open the breech and remove the powder charge. Place the loading tray in position in the breech recess. Inspect the unloading rammer head to see that it is thoroughly clean and of a type containing a suitable recess for inclosing the fuze. Insert the rammer head into the bore from the muzzle end and push it carefully until it incloses the fuze and comes into contact with the ogive of the projectile. Push the projectile back slowly onto the loading tray. It may be necessary to tap the end of the rammer staff with a wooden block in order to dislodge the projectile from its seat in the bore. Hold an extra rammer, if available, otherwise a pickax handle, firmly against the base of the projectile and steady its backward movement until it comes to rest in the loading tray.

23. TO PLACE THE GUN AND HEAVY FIELD CARRIAGE IN TRAVELING POSITION.

a. **Raise carriage.** Detach the rear spades from the trails. Operate the bogie lifting mechanism to raise the carriage from the ground. Swing the trails together. Raise the carriage as high as the lifting mechanism will permit. Detach the front spades. Place the front and rear spades in their carrying racks on the trails. Detach the wheel supporting cables from the bolts on the bogie cross beam and hook the cable eyes on the brackets provided on the upper torque rods. Place the bogie elevating screw lock in position on top of the bogie elevating screws.

b. Install limber.

(1) INSTALL HEAVY CARRIAGE LIMBER M5.

(a) Place the trail clamping bracket T-bolt in the spade recess on the trails when closing the trails. Aline the trail clamping bracket over the T-bolt and trails. Position the trail clamping bracket bolt

Part Two — Operating Instructions

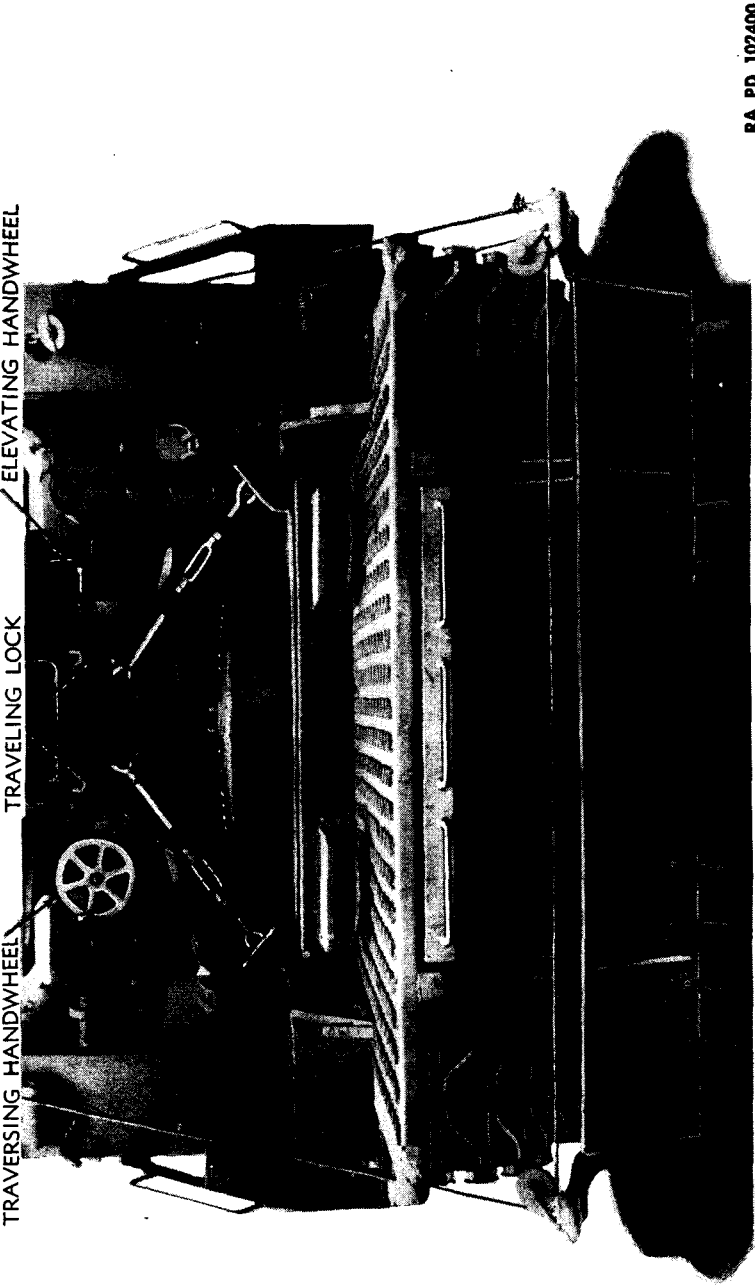
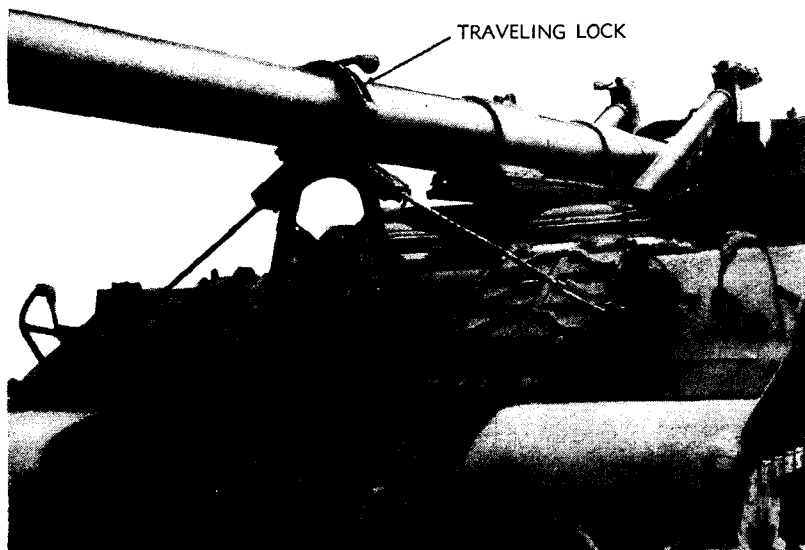


Figure 43 — Gun Motor Carriage Traveling Lock

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RA PD 102397

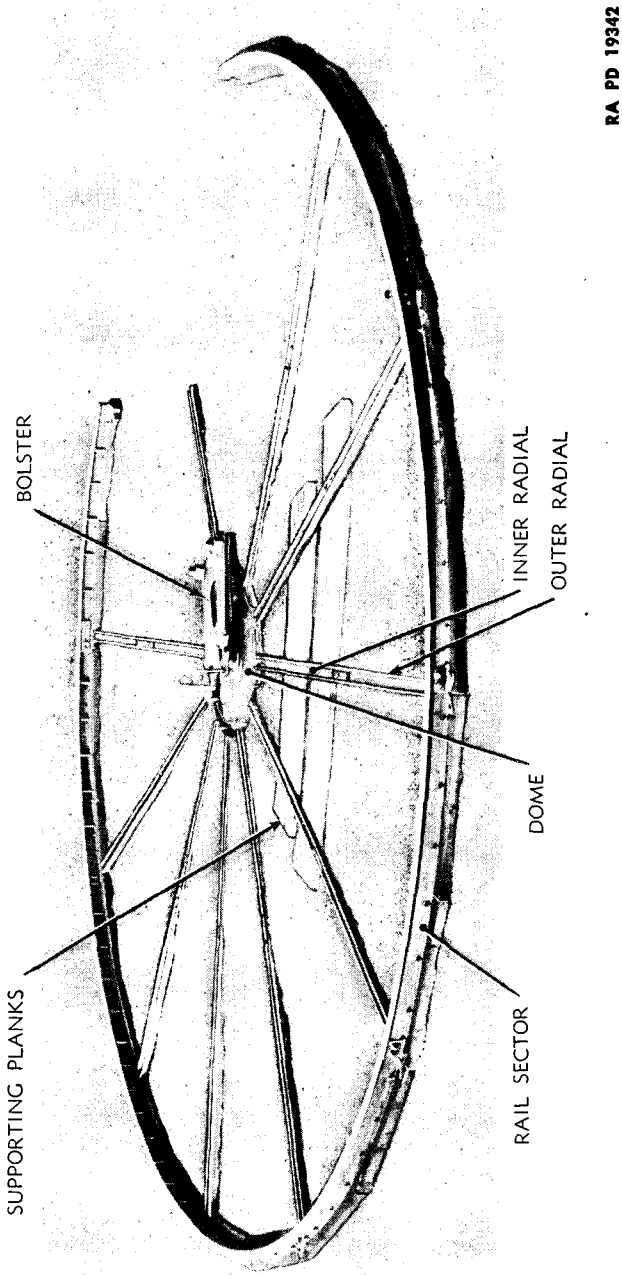
Figure 44 — Gun Motor Carriage Front Traveling Lock

and install nuts on the bolts. Tighten with the double-headed box wrench issued with the limber. Lock in place by inserting the safety pins (fig. 35). **CAUTION:** *One or more threads should be showing above the nut.*

(b) With the limber hooked to the prime mover, align the limber with the trail clamping bracket. Pay out the winch cable on the prime mover enough so that it can be connected to the lifting sling on the limber frame. Take up the slack until the cable and sling are taut. Make certain that the sling is in line with the lifting sling guide. Remove the eyebolt from its carrying position in the front of the limber by loosening the wing nuts and removing the hinge pin (fig. 37). Pay out cable from winch to allow the lifting bracket assembly to rotate and swing down to the lifting position. Align the lifting bracket with the trail clamping bracket. Screw assembling nose onto the trail coupling pin and insert pin to connect the limber lifting bracket to the trail clamping bracket. Limbers equipped with coupling pins that are secured by means of a tapered key do not require this assembling nose. Remove the nose from the trail coupling pin, and screw on the bar wing nut. Insert the trail coupling lock pin.

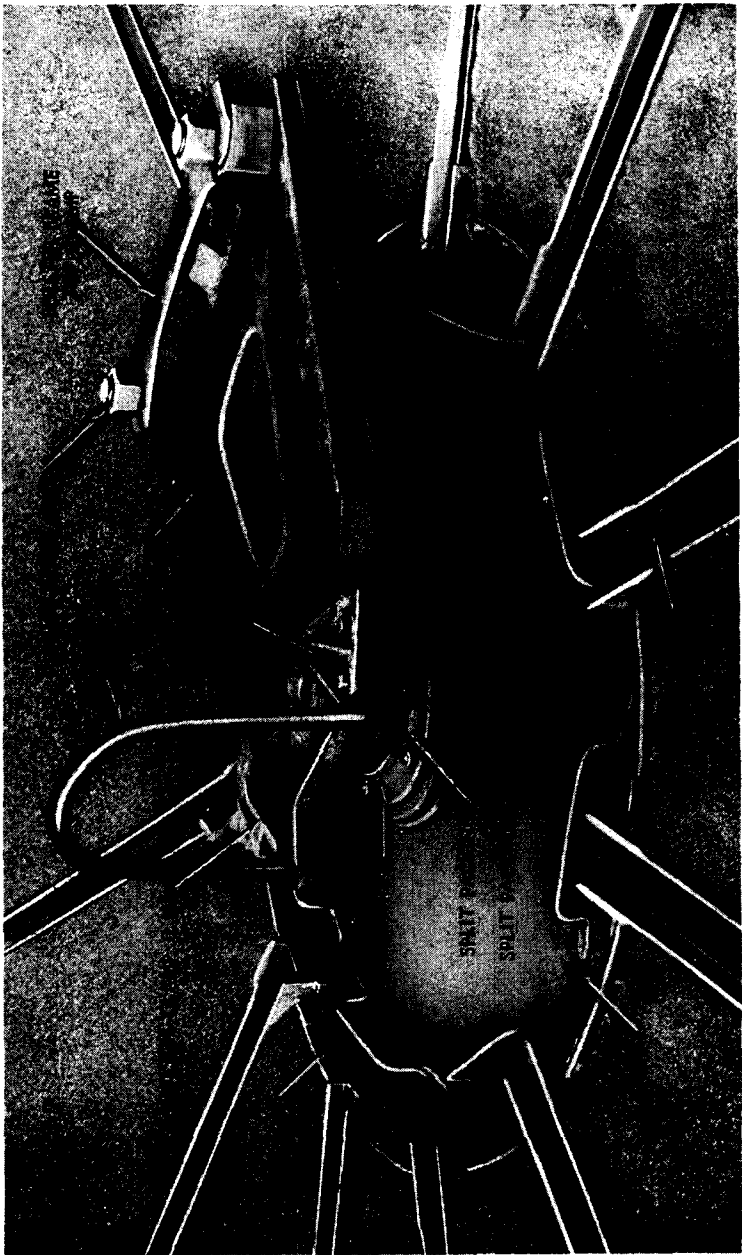
(c) Unlock brakes on gun carriage, and, using powered winch, take in cable slowly. This will rotate the lifting bracket assembly and lift the trails to the traveling position. **CAUTION:** *Personnel must stand clear of the limber and trails and the operator of the prime*

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RA PD 19342

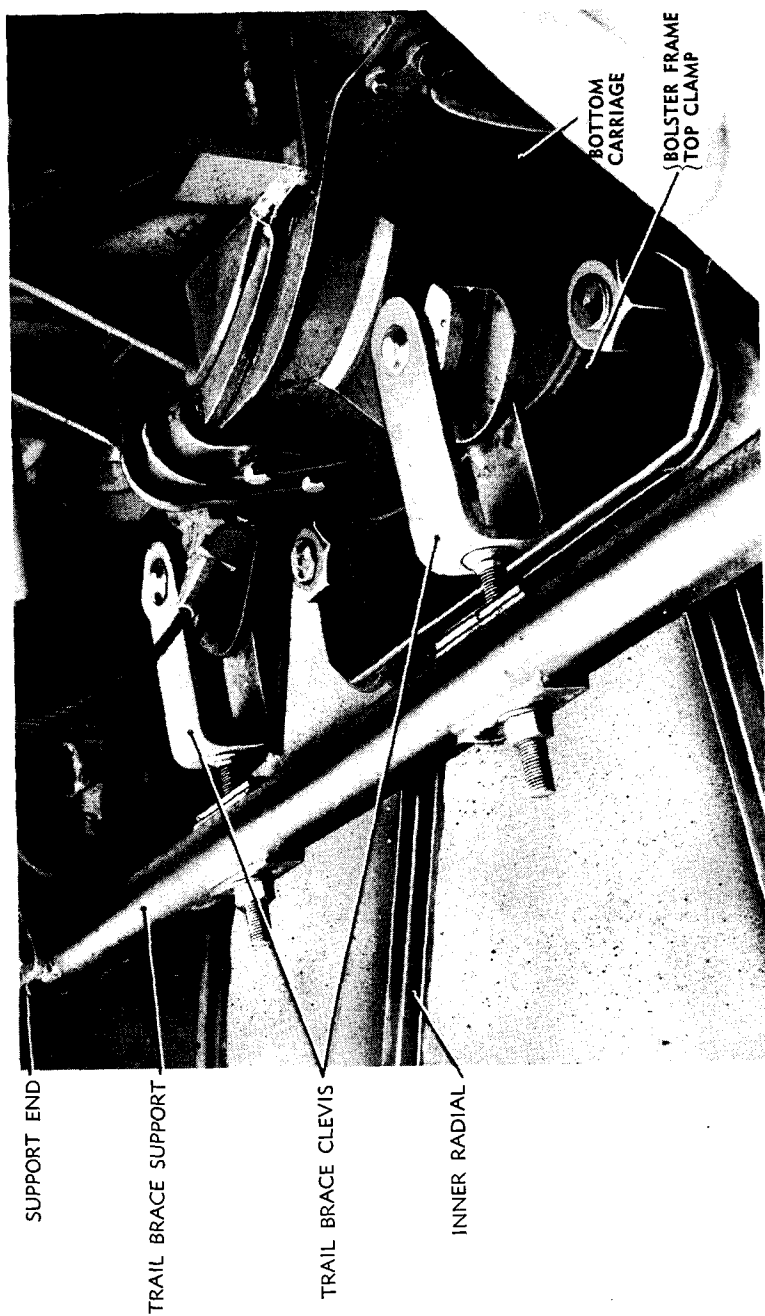
Figure 45 — Firing Platform — Assembled for Mounting Carriage



RA PD 19350

Figure 46 — Firing Platform — Bolster in Position

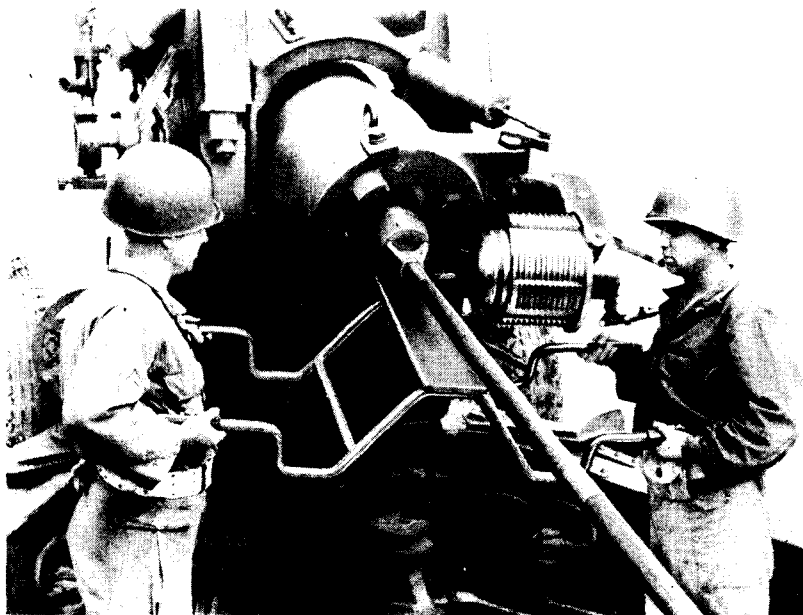
Part Two — Operating Instructions



RA PD 19352

Figure 47 — Trail Brace in Position

Part Two — Operating Instructions



RA PD 102409

Figure 48 — Loading Projectile

mover winch should exercise care in powering the winch. The carriage will move forward a few feet during this operation.

(d) Reset the hand brakes on the carriage. Keeping clear of the trails, place lifting and locking eyebolt down through trail clamping bracket between the trails. Lock in place with eyebolt hinge pin (fig. 35). Lay eyebolt spacer piece in position, start wing nuts (fig. 34) and tighten securely, using a rawhide or copper hammer. Insert cotter pin. When eyebolt is securely in place, remove lifting sling from winch cable and attach sling to hook on the trail (fig. 33). Wind up winch cable.

(2) **INSTALL HEAVY CARRIAGE LIMBER M2.** Move limber assembly into position at rear of trails with limber lifting mechanism screw between lock plates on trails. Run the limber lifting screw down by turning handle of limber lifting mechanism until guide arms are in guides. The elevating screw is then operated to raise the trails until they are in position in the spring supported seat and clamped there by lifting screw. Replace the lifting screw cover. Fasten the trail locking pins.

c. **Connect air brake hose.** Couple air brake hose together, passing them through hose guide. Hose are arranged for straight connections between limber and prime mover, and for cross connection between limber and trails (fig. 33).

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RA PD 104388

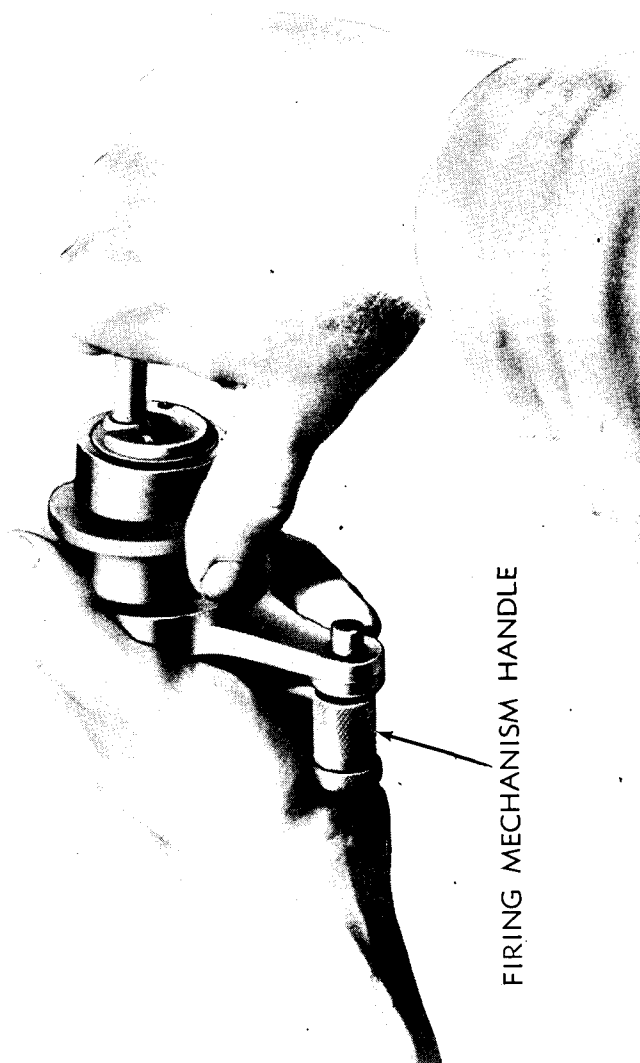
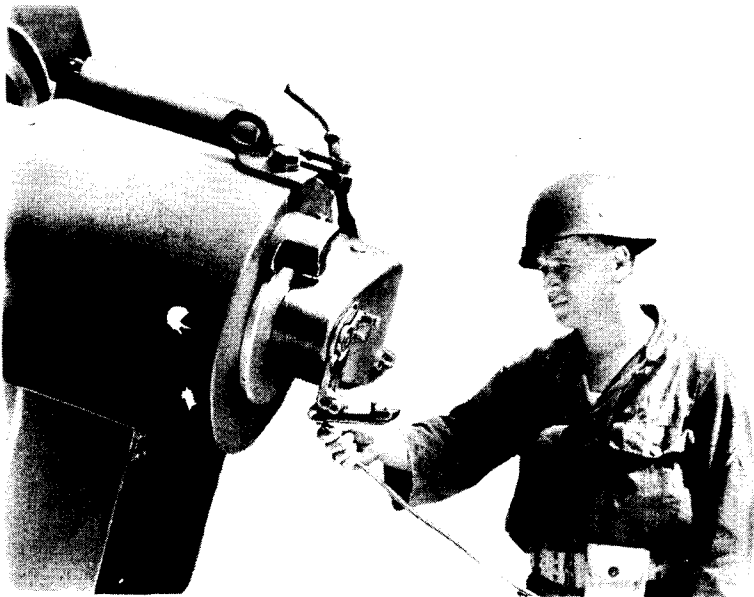


Figure 49 — Sliding Primer Into Place in Firing Mechanism M1

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RA PD 102386

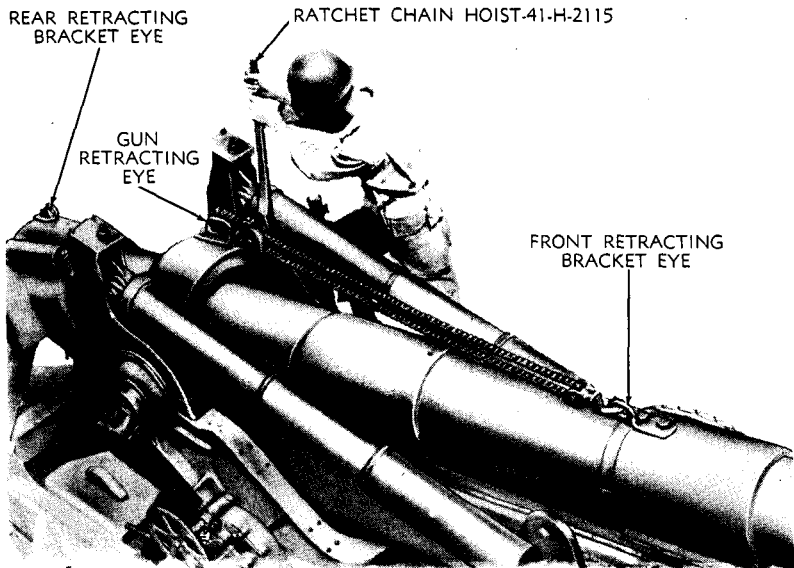
Figure 50 — Attaching Lanyard to Percussion Hammer

d. Inspection. A thorough inspection of the assembled limber should be made before moving. Points to be covered are:

- (1) Trails must be seated properly on limber lifting bracket (limber M5). Trails must be locked properly by trail locking pins (limber M2).
- (2) All nuts must be drawn up tight and locked with cotter pins.
- (3) The eyebolt must be drawn up tight by the two wing nuts (limber M5).
- (4) Air hose must be installed properly and be free to turn with the limber.

e. Retracting the tube (fig. 51).

- (1) Connect cradle lock to the cradle.
- (2) Place gun traveling lock in position over brackets on trails. Lock in position. Attach traveling lock cable clevis to bracket on rear of bottom carriage. Secure clevis pin with cotter pin.
- (3) Remove cotter pins, and nuts from counterrecoil and recoil piston rod ends. Pull barrel assembly to rear and lock it securely in place on traveling lock with locking pin. **CAUTION:** *The piston rod nuts must not be removed until cradle lock and traveling lock are in position.* Replace the nuts and cotter pins on the recoil and counterrecoil rod ends.

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RA PD 102398

Figure 51 — Retracting the Gun Into Traveling Position

- f. Lock traversing mechanism by rotating the traversing brake handle clockwise.
- g. Remove panoramic telescope from its mount and replace it in its carrying case.
- h. Replace breech and muzzle covers.

24. TO PLACE THE GUN AND HEAVY FIELD CARRIAGE IN TRAVELING POSITION WITH THE FIRING PLATFORM M1.

- a. For emplacing, dismantling, and storing the firing platform, see paragraph 27.
- b. Remove push bar assembly. Remove yoke bar and bolster clamp from the bolster. Remove two nuts from rear bolster and remove the carriage clamp. Remove two rail sectors in order that the gun may be rolled out. Place gun in traveling position and tow away from firing platform. Remove bolts holding rail sectors together, and remove bolts that hold the outer radials to the rail sector. Remove rail sectors.
- c. After the gun has been unclamped and dismantled from the bolster, further procedure for limbering up preparatory to travel and towing is the same as prescribed for the heavy field carriage (see par. 23).

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25. TO PLACE THE GUN IN TRAVELING POSITION ON THE GUN MOUNT M13.

a. **Fix tube position.** Bring the weapon to a horizontal position in the center of traverse.

b. **Clean and oil gun.** Clean, thoroughly dry, and cover the bore, powder chamber, breech recess, breechblock, and firing mechanism with a thin coat of light oil; oil the top and bottom carriages. Lock the percussion hammer in traveling position.

c. **Stow tools, equipment, and ammunition.** Return sighting equipment, firing tools, and accessory equipment to their proper stowage position in chests, in brackets, and in clips on the vehicle. Store the ammunition, and close and store the powder containers.

d. **Install gun covers.** Install the breech, muzzle, and sight mount covers.

e. **Fasten traveling lock.** Unlatch and swing traveling lock up to a vertical position. Clamp upper half of lock around tube. Tighten nut. Tighten cradle traveling tie rods.

f. **Raise spade.** Move the vehicle forward to free the spade from the earth. Crank up spade winch, and lift spade to traveling position. Insert spade support arms through brackets and insert locking pins.

Section VIII**OPERATION OF AUXILIARY EQUIPMENT**

26. GENERAL. Operation of sighting and fire control equipment is covered in section XXVIII.

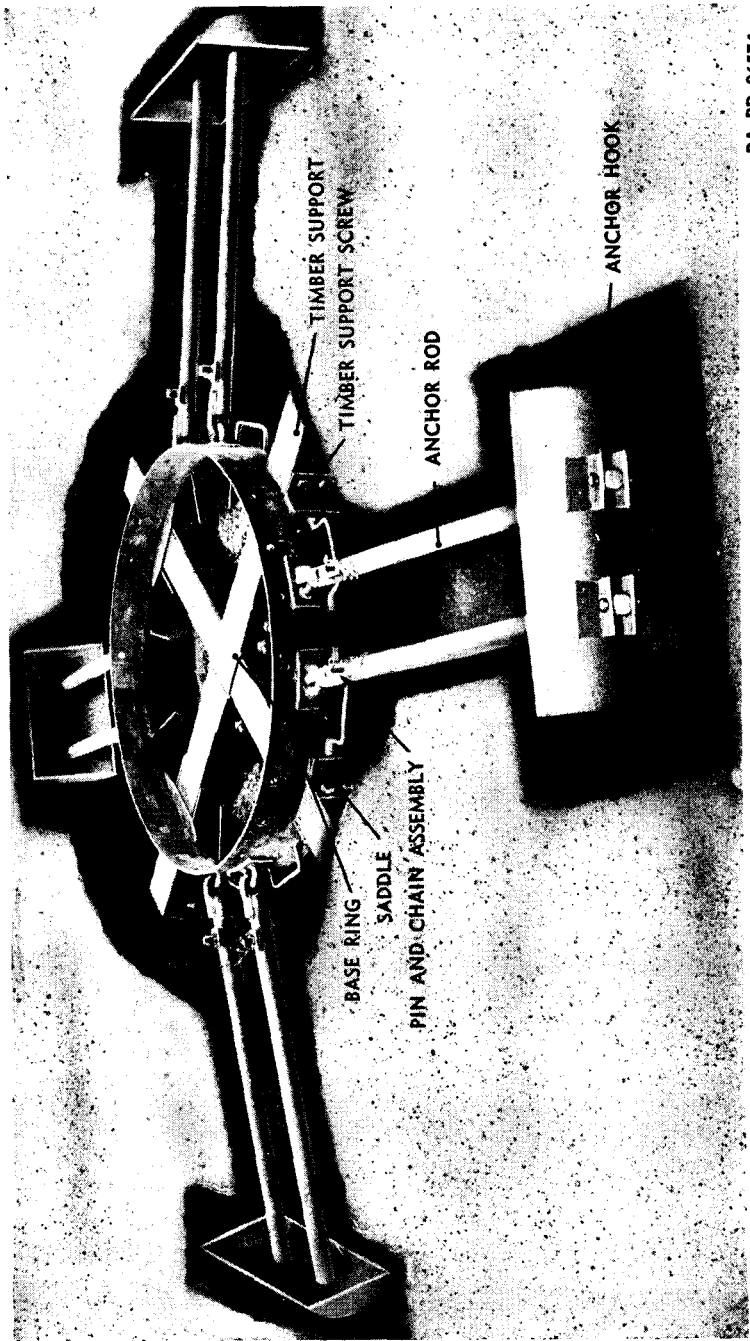
27. FIRING PLATFORM M1.

a. **General.** The operation of the firing platform M1 consists of: emplacing the platform preparatory to mounting the gun and heavy field weapon in firing position upon it; dismantling the platform after weapon has been pulled off of it and stowing the platform for traveling.

b. **Emplacement.**

(1) Select a position for firing that is fairly level within a 37-foot diameter. Dig a circular pit 10 feet in diameter and 18 inches deep. Place long 8, by 8-inch timber support in approximate center of hole (figs. 52 and 53). Assemble saddle over timber and bolt short timber supports in place. Lower base ring in place over supports. Raise supports and align bolt holes in timbers with holes in base ring. Bolt in place. To increase flotation in soft or sandy soil, place planks

Part Two — Operating Instructions



RA PD 86574

Figure 52 — Base Assembly

Part Two — Operating Instructions

RA PD 86535

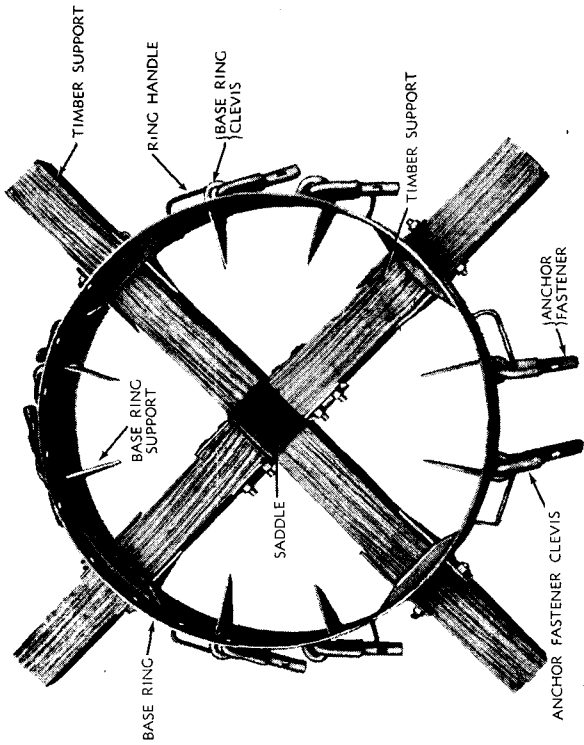
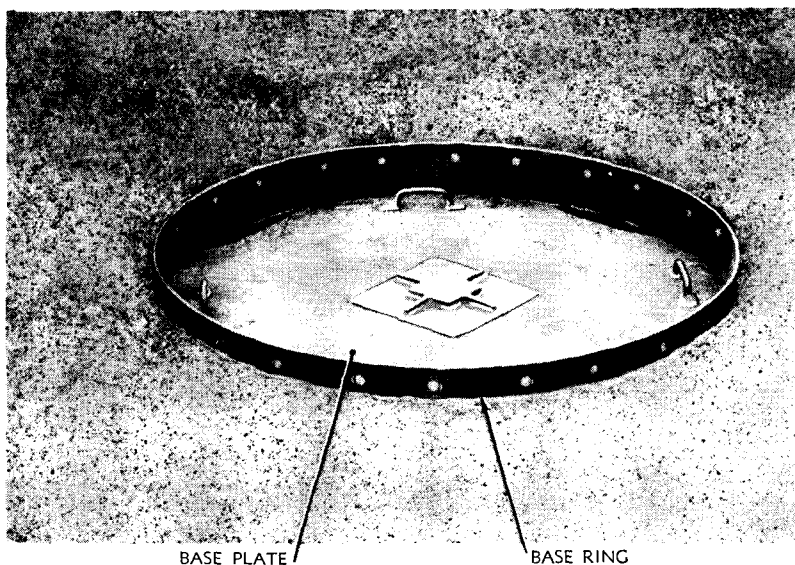


Figure 53 — Base Ring and Supports

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RA PD 19347

Figure 54 — Base Plate in Position

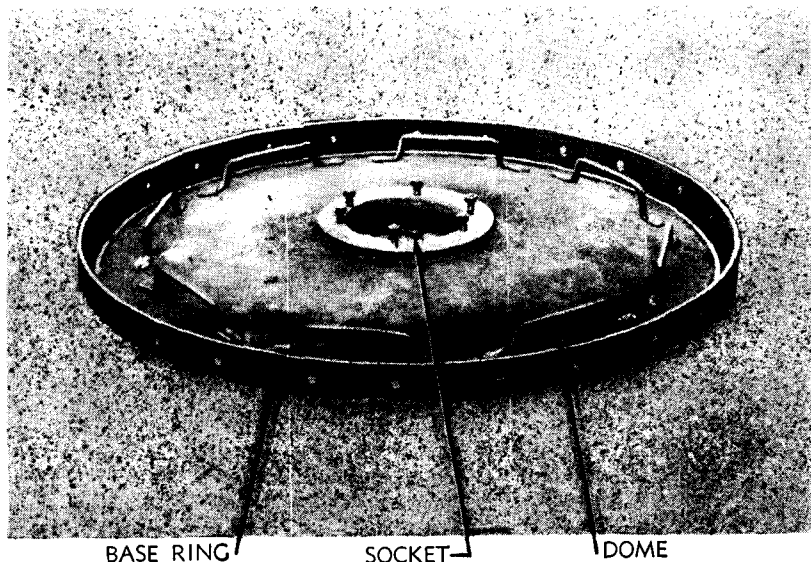
under the ends of the timber supports. Fill under the supports with dirt and tamp in solid. Fill in ring with dirt to the top level of the base ring supports and tamp level.

(2) Dig out four pits, large enough for the anchor hooks, 30 inches deep (fig. 52). Assemble anchor rods and anchor hooks. Assemble anchor rods to the anchor rod fasteners on the base ring. Insert pin and tap in place. Fill in around the outside of the base ring, and over the anchors with dirt and tamp until firm (fig. 54). Do not fill dirt in even with top of base ring. Room must be left for planks to fit under the inner radials.

(3) Lower base plate in position in base ring. Make sure the plate sits firmly on the timber supports. Place the dome assembly on top of the base ring (fig. 55). Lay planks around outside of base ring. Attach inner radials to top of base ring and bolt in place. The radials must rest on top of the planks. Remove the socket cover plate.

(4) Assemble the large split ring over the bolster ball (fig. 60). Place the split packing and packing ring on large split ring, and bolt in place. Lower bolster (fig. 61) into dome socket. Aline the holes in the split ring with the studs on the dome. Set the bolster ball completely in the socket. Fasten in place by tightening nuts on dome studs.

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RA PD 19348

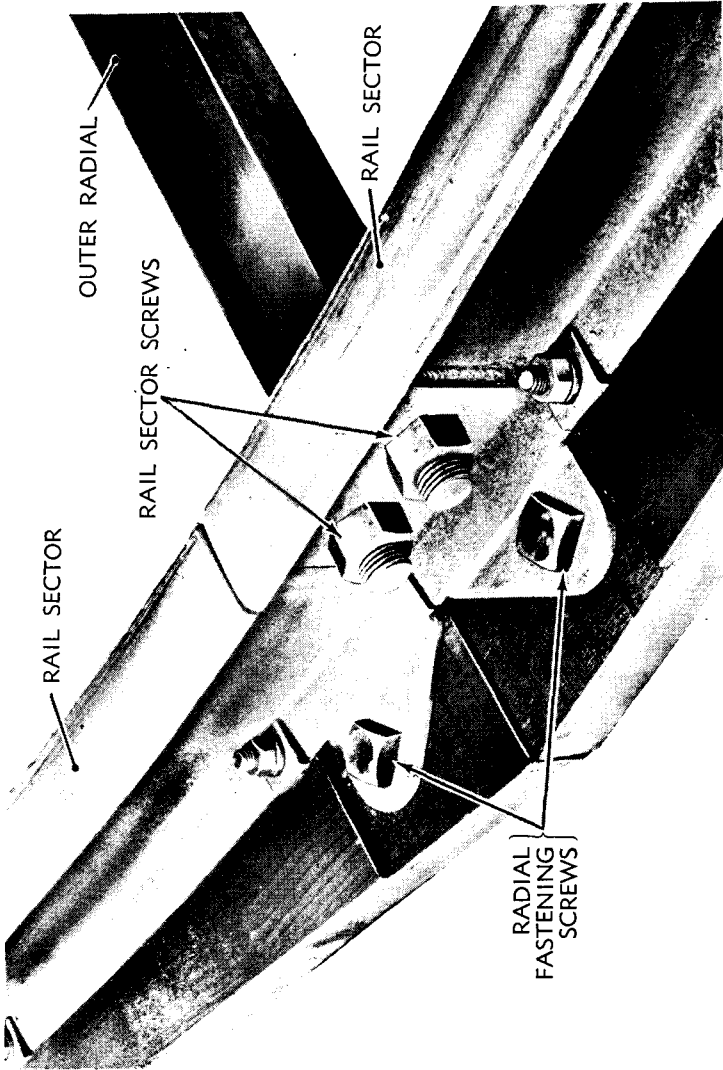
Figure 55 — Dome in Position

(5) Attach outer radials to inner radials (fig. 63) and bolt in place. Lay the rail sectors (fig. 66) in position and fasten together. Attach outer radials to rail sectors at point where sectors join (fig. 56).

(6) With two rail sector assemblies removed to permit entrance of carriage, back carriage into position and aline bottom carriage directly over bolster (fig. 45). The lower front spade supports must fit over the studs on the bolster, and permit the pivot blocks to be placed in position. Lower carriage on the bolster by raising bogie. During the operation of lowering the carriage, the gun and carriage may have to be maneuvered slightly to properly aline the bolster and bottom carriage. When bottom carriage is in position on the bolster, lower the trails from the limber. Place bolster clamps on bolster, and bolt in place. Drop yoke bar over bottom carriage and tighten locking nuts. Place pivot blocks in position in bottom front spade supports. Place bolster frame clamp over spade supports and lock with two nuts.

(7) Assemble remaining rail sections and attach remaining radial. Assemble trail clamps (fig. 62) and rubbing plates on rail sectors with hooked bolt on outside of rail. Slide trail clamps into the trail spade seats. Fasten with trail spade key.

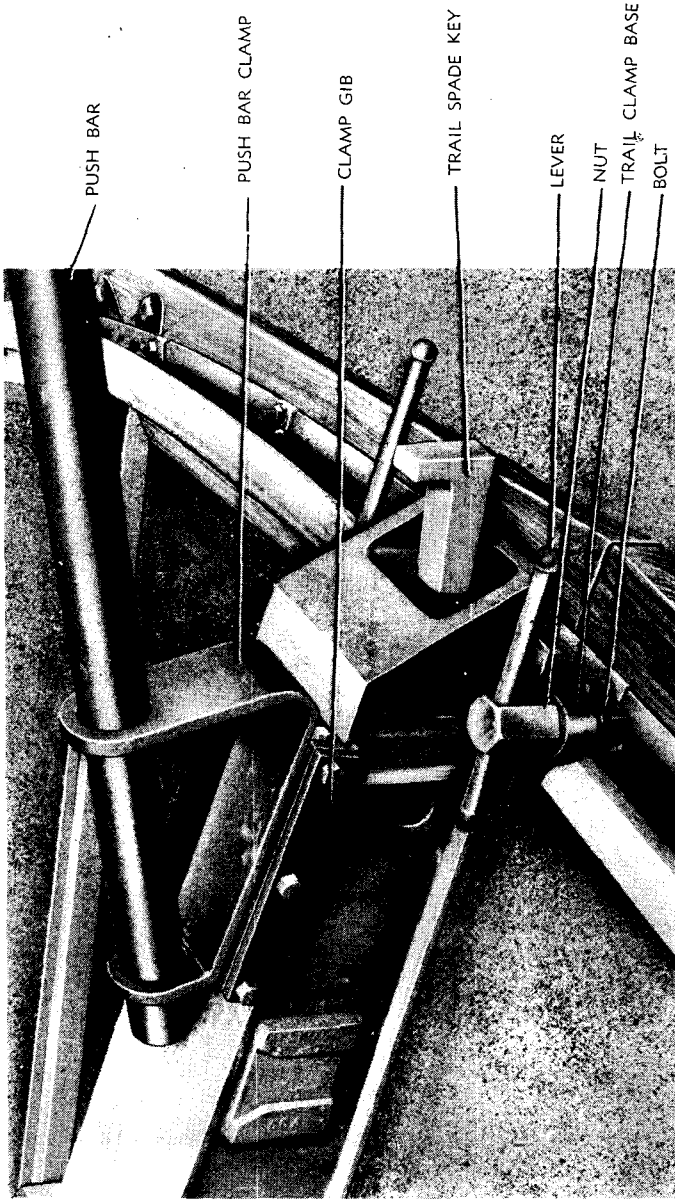
Part Two — Operating Instructions



RA PD 19338

Figure 56 — Method of Attaching Radials

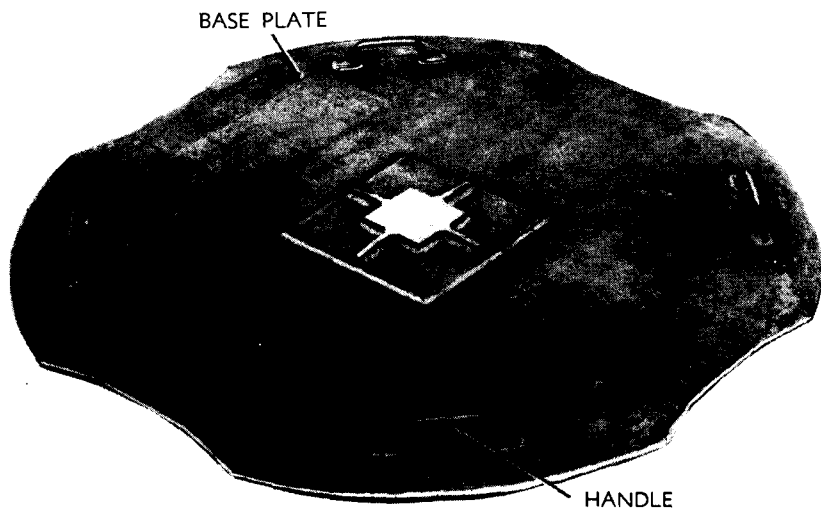
Part Two — Operating Instructions



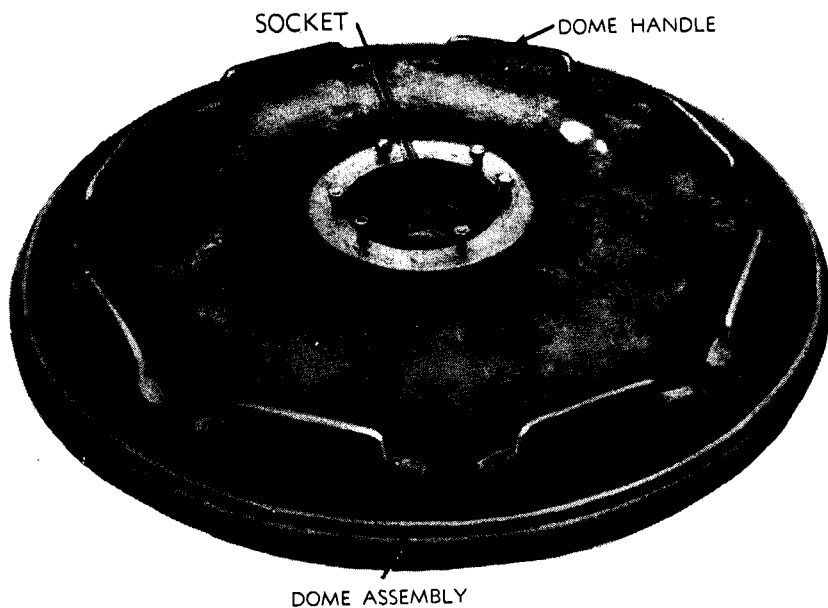
RA PD 19334

Figure 57 — Trail Clamp and Push Bar

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RA PD 86540

Figure 58 — Base Plate

RA PD 86541

Figure 59 — Dome Assembly

RA PD 86575

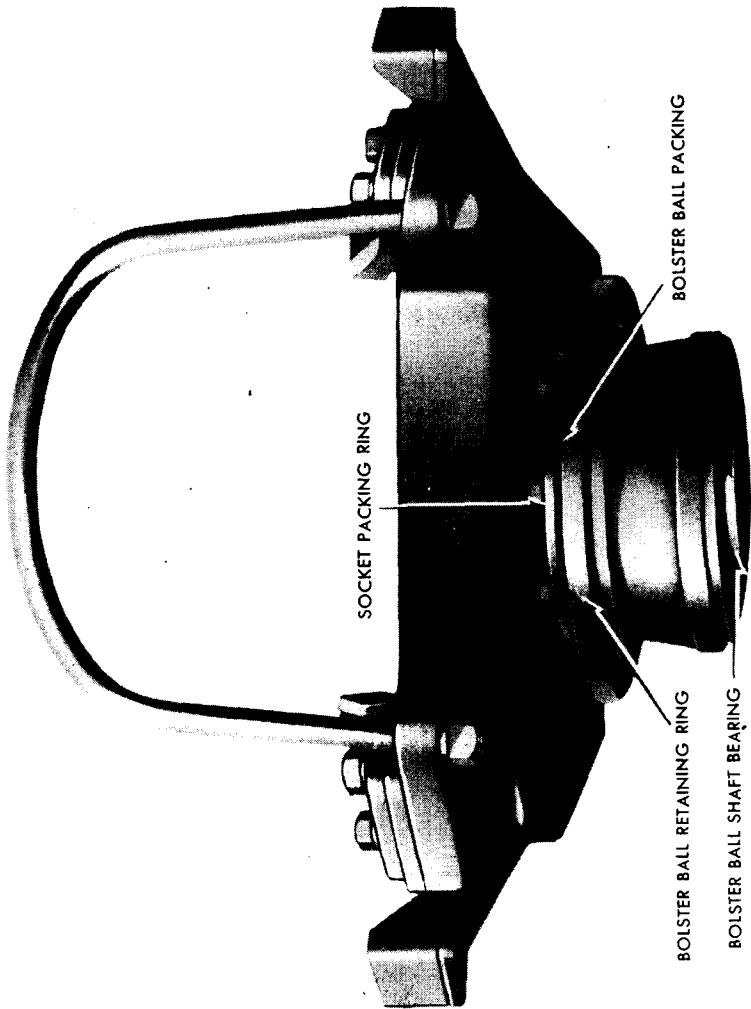
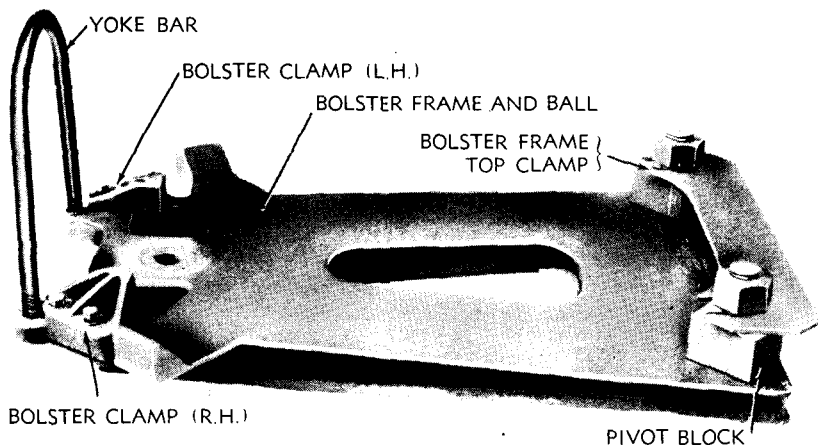


Figure 60 — Bolster and Bolster Ball Retaining Ring — Front View

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RA PD 86547

Figure 61 — Bolster Assembly

(8) Assemble trail brace (fig. 64), and hook the trail brace clevises over the top front spade supports. Tighten up clevis nuts, making sure that the support ends engage the trails properly. Assemble push bar assembly (fig. 65) on end of trails. The push bar assemblies must have the clamp gib on the outside of the trails. Drive stakes around the outside of the rail sectors.

c. For mounting the gun and the carriage upon the platform, see paragraph 24.

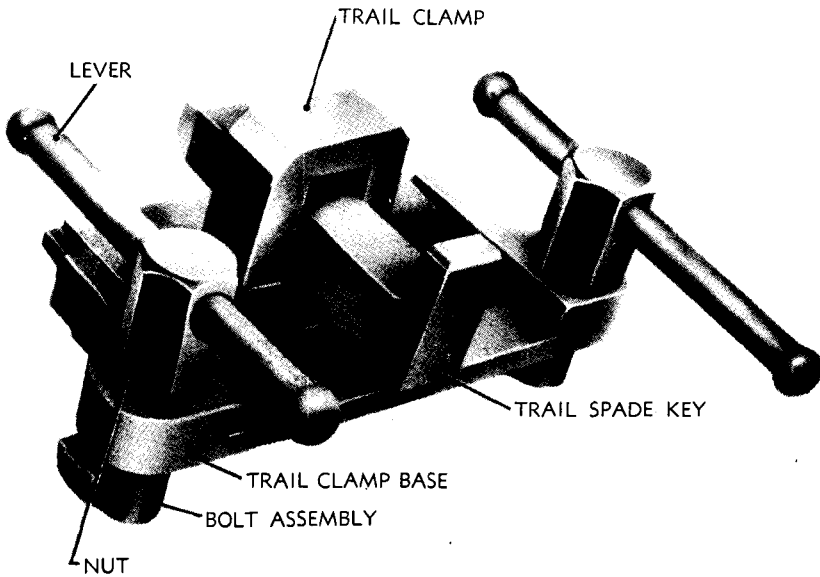
d. Dismantling.

(1) Remove trail base locking nut and remove trail brace. Withdraw trail spade key. Loosen trail clamp assembly and slide out of trail spade seats.

(2) Remove push bar assembly. Remove yoke bar and bolster clamp from the bolster. Remove two nuts from rear bolster and remove the carriage clamp. Remove two rail sectors in order that the gun may be rolled out. Place gun in traveling position and tow away from firing platform. Remove bolts holding rail sectors together, and remove bolts that hold the outer radials to the rail sector. Remove rail sectors.

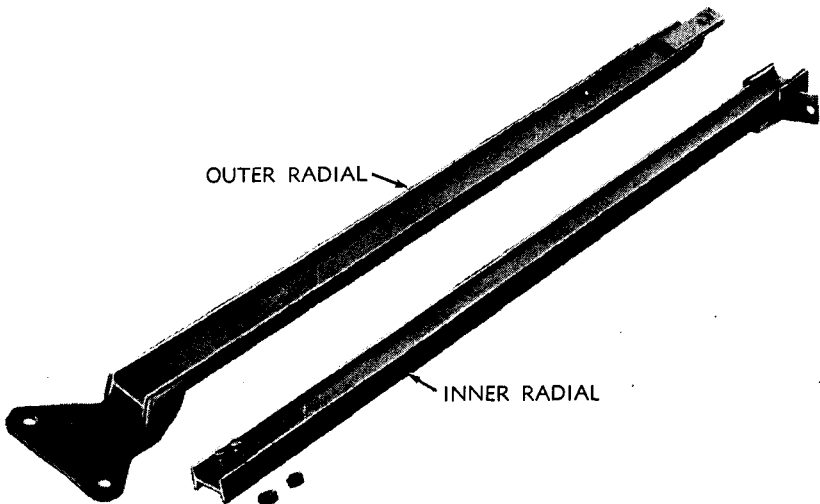
(3) Disconnect inner and outer radials. Remove inner radials from the base ring. Remove planks that support inner radials. Remove nuts from the dome studs that hold the large split ring in position. Remove screws from the large split ring, and remove the small split ring and split packing. Lift out bolster. Lift dome assembly out of base ring (fig. 59). Lift out base plate (fig. 58).

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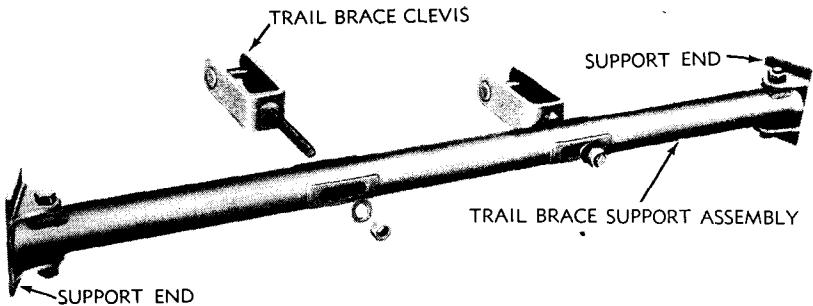
RA PD 86549

Figure 62 — Trail Clamp Assembly

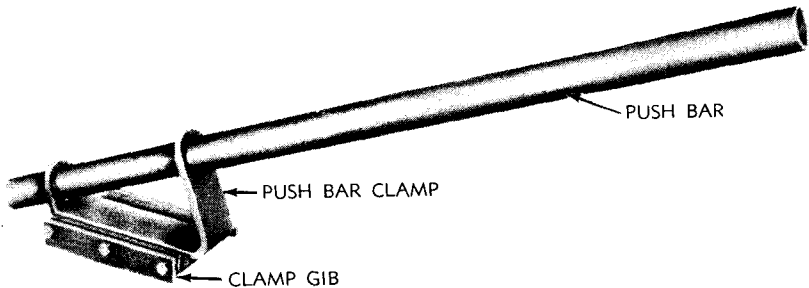


RA PD 86548

Figure 63 — Radials

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RA PD 86566

Figure 64 — Trail Brace Assembly — Exploded View

RA PD 19349

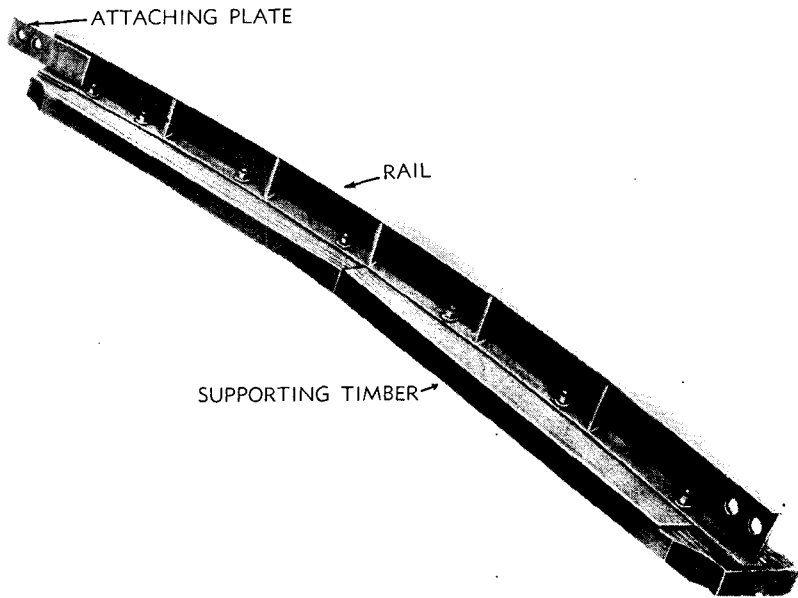
Figure 65 — Push Bar Assembly

(4) Dig out anchor rods, anchors, and timber supports. Withdraw anchor rod locking key and remove anchor rods and hooks. Remove timber support screws in base ring and lift base ring off the timbers. Unbolt short timbers from the saddle. Remove timbers and saddle. Remove long timber support.

e. Stowage.

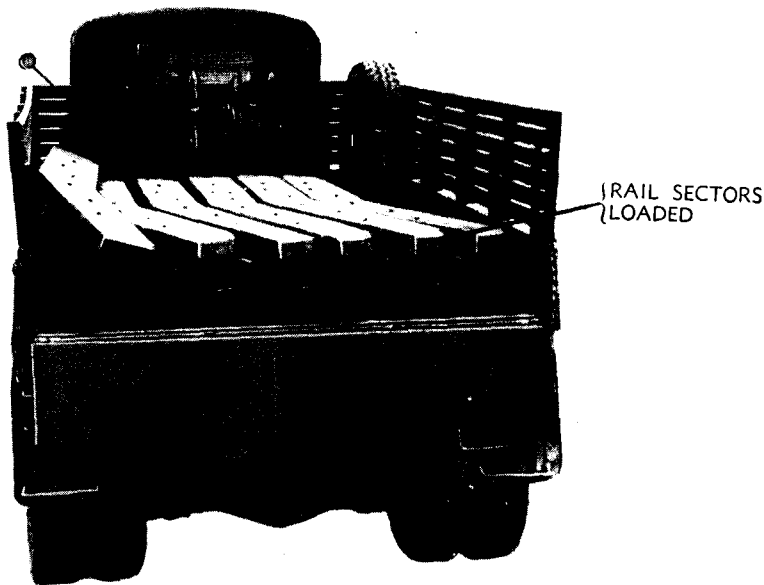
(1) The following illustrations (figs. 67 and 68) show a method of stowing the materiel on a 6-ton, 6 by 6 truck. The Mack 7½-ton, 6 by 6 is normally used as the prime mover and the load may be spread out more, due to a larger load capacity. The tail gate should be closed before traveling is attempted, to prevent the load from working out. No dunnage is required with the exception of planks under the base ring to keep the ring from bearing on the rail sector. The platform stowage as shown on figures 67 and 68 is satisfactory for primary and secondary roads. Greater care should be taken to prevent damage to the base ring when cross-country travel is attempted. A 4-ton, 6 by 6 cargo carrier can also accommodate the firing platform M1 with the truck trail gate closed.

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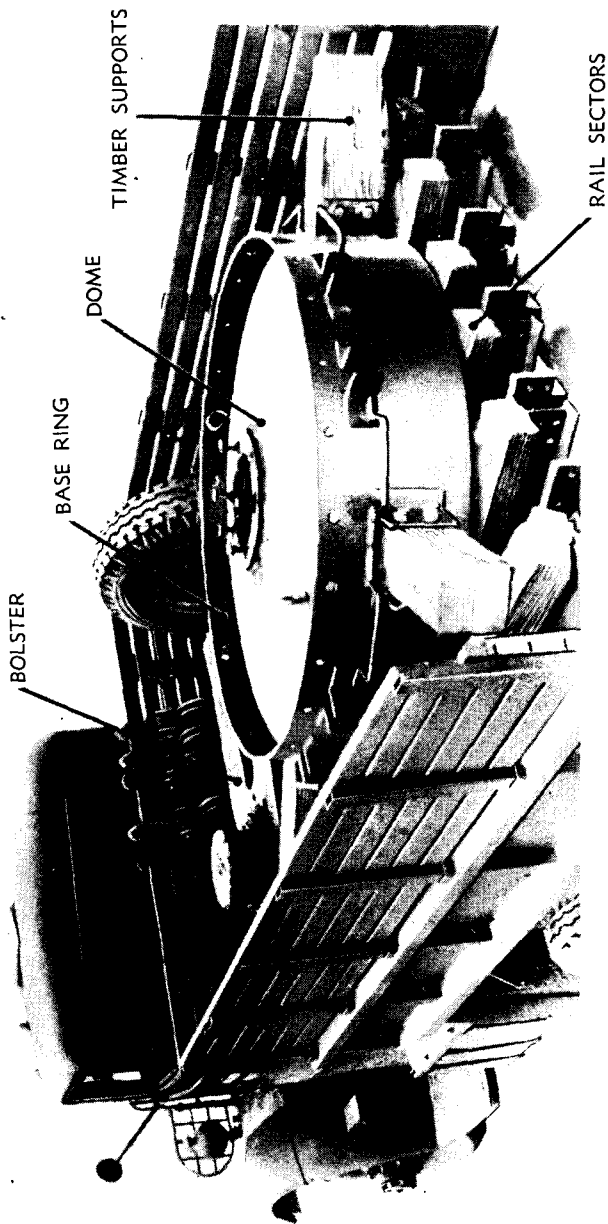
RA PD 19339

Figure 66 — Rail Section



RA PD 22425

Figure 67 — Rail Assembly Loaded (6-ton, 6 x 6)



RA PD 22426

Figure 68 — Dome and Bolster Assembly Loaded (6-ton, 6 x 6)

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(2) Storage of the anchor rods, anchor hooks, radials, push bar assemblies, and trail clamps are not shown. These parts may be stowed in any manner to prevent shifting or bouncing during transit. Proper procedure is left to discretion of personnel responsible for transporting materiel.

Section IX**OPERATION UNDER UNUSUAL CONDITIONS**

28. GENERAL. When operating the materiel under unusual conditions such as extreme high temperatures, extreme low temperatures, severe dust, sand, or near salt water, the precautions given in this section must be followed. For lubrication instructions see section XIII.

29. COLD WEATHER.**a. General.**

(1) Operation of the 155-mm materiel at subzero temperature presents problems that demand special precautions and careful servicing by using organizations and maintenance personnel to avoid poor performance and/or total functional failure, and, in some instances, damage to both materiel and personnel.

(2) Artillery will operate efficiently if the instructions contained herein are following when temperatures below 0° F prevail or when sluggish or stiff operation of materiel indicates the advisability of adopting them at higher temperatures.

b. Mechanical condition of materiel.

(1) Since metals contract when the temperature decreases, and expand when the temperature increases, the clearance between bearing surfaces is considerably less at subzero than at higher temperatures. In preparing artillery for subzero temperature operation, care must be taken to make certain that parts are alined properly and normal clearances exist, not only in bearings but also in mechanisms employing packings around rotating or reciprocating shafts and rods. Lack of attention to this may result in binding which will make mechanisms stiff or inoperative regardless of the lubricant used. Scored or roughened bearings and other rubbing surfaces, such as cams and recoil slides also interfere with easy action and should be smoothed in preparing artillery and fire control materiel for low temperature operation.

(2) Cleanliness is imperative. Rust, dirt, gummy oil, and grease in bearing clearances reduced by low temperature, interferes with proper distribution of lubricant, thus causing stiff action, if not complete stoppage. In "winterizing" materiel, therefore, assemblies and

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mechanisms must be disassembled sufficiently to permit thorough removal of oil, grease, and foreign matter. Cleaning is most efficiently done by washing with dry-cleaning solvent, employing brushes and scrapers where necessary. Care must be taken not to overlook cleaning small items that may appear insignificant. Field experience has proved that neglect in cleaning small linkages, bearings, and other similar parts often causes malfunctioning and stoppages in subzero weather.

(3) Placing of materiel in proper mechanical condition requires time for necessary disassembly, repair, and cleaning and must be carefully done. The approach of low temperatures must be anticipated far enough in advance to permit ordnance maintenance personnel sufficient time to make necessary disassembly and assembly and to complete conditioning before onset of subzero temperatures.

c. Low temperature lubrication.

(1) Lubricating oils stiffen progressively, as temperature falls, until a point is reached at which they solidify. As stiffness increases, the power required to move surfaces of bearings and gears in contact with the oil multiplies rapidly, until movement becomes impossible. When solidification occurs, the moving parts cut a channel through the oil, leaving the rubbing surfaces dry and unlubricated. Before friction can develop sufficient heat to liquefy the oil and reestablish an oil film, bearing and gear tooth surfaces may score and cause complete failure of the mechanism. Similar action takes place where rubbing surfaces are fed by an oil pump. The stiffened oil flows too slowly, or not at all, to the pump inlet, and the oil already in the feed lines cannot be forced to the bearings. Oils prescribed for use in artillery materiel at high temperatures must be designed to maintain adequate body at those temperatures and, in most instances, they become too stiff at low temperatures to permit satisfactory operation. Oils must therefore be completely replaced in cold weather with lighter oils which will remain fluid at the lowest expected operating temperatures.

(2) The proper lubricants to be used for cold weather operation are prescribed in the lubrication orders, figures 72 and 73.

d. Low temperature operating instructions.

(1) **EMPLACING.** When emplacing a weapon, it is well to coat all metal parts which come in contact with the snow or ground with a film of grease. This will prevent freezing to the ground and will facilitate moving the mount to the traveling position. Firmly rolled or compacted snow will provide a satisfactory emplacement. Digging of the recoil and spade pits will be difficult. It may require chopping of the frozen ground to get started.

(2) **TRAVEL.** Before starting a road trip, a thorough inspection of the weapon should be made. Provide as much protection to all

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parts as possible. Be sure all covers are properly assembled and securely lashed. If the gun cover is not adequate, cover exposed portion with available materiel. Suspension assemblies will be stiff, therefore, more care than normal should be emphasized when traveling over rough terrain. Tires cannot be expected to take the abuse in extremely cold weather that they would under former conditions.

(3) **CARE.** All mechanisms should be exercised frequently. Traversing and elevating of the gun will be extremely helpful in reducing handwheel efforts. Exercising of the suspension systems will help to keep those parts from freezing. Periodic and frequent inspection to prevent snow and ice collecting on moving parts will result in keeping the gun in service. Always use gun covers and shelter, where possible, to provide the maximum protection for the gun and mount. These points cannot be overemphasized: clean all parts thoroughly, lubricate sparingly, guard against collection of snow and ice, leave no metal surfaces exposed without a protective film of lubricant, and if there is evidence that materiel is "sweating," dry thoroughly, clean, and renew lubricant film.

(4) **GUN COVERS.** Whenever the weapon is to remain idle for a period of time, care should be taken to secure the gun covers for protection of the weapon. Wind will drive the snow up under the gun covers unless they are securely fastened. This will result in formation of ice, which renders the gun inoperative.

e. Gun bore cleaning.

(1) If the tube can be cleaned while hot, rifle bore cleaner may be used in the normal manner as prescribed in paragraph 58, or if this cleaner is not available, normal soda-ash or soap solutions may be used. Cleaning a cold tube below a temperature of $+32^{\circ}$ F cannot be accomplished in the normal manner, due to freezing of the cleaner in the tube. Under such conditions cleaning should be done with the normal soda-ash or soap solutions which are prevented from freezing by the addition of alcohol, or as an emergency alternative, glycerine or antifreeze compound (ethylene glycol type). To 10 parts by volume of soda-ash or soap solution add the number of parts of one of the antifreezes shown below:

CAUTION: *Do not add these antifreezes to rifle bore cleaner.*

Temperature, °F	Alcohol	Glycerine	Antifreeze Compound
20	2	2½	2
10	4	5	3⅓
0	6½	6½	5
-15	9	10	7¼
-30	16	13	10
-40	27	16	12

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(2) In applying oil to the bore after cleaning, care must be taken to work the oil in well so that it will reach all surfaces of the lands and grooves. When gun is brought into a heated shop, condensation will occur on all metal surfaces. After the gun reaches shop temperature, the tube and all other bright parts must be wiped dry and re-coated with oil to prevent rusting.

(3) When materiel is protected with a canvas or other type cover, moisture will form on the metal surfaces. To prevent rusting, the cover must be removed at least weekly and all surfaces thoroughly dried and coated with oil.

f. Breech assemblies.

(1) **CLEANING AFTER FIRING—COLD WEATHER.**

(a) Cold weather necessitates a very thorough cleaning of breech mechanism after firing. **CAUTION:** *Be extremely sure all traces of snow and ice are removed.*

(b) *Care during inactive periods.* Temporary inactive periods necessitate preservation of breech mechanism and also preparation for almost instant use. After cleaning the breech assembly and while the mechanism is still disassembled, apply a light, thorough coat of oil. It must be kept in mind that less preservative is needed for protection against corrosion in cold weather than normally. A thin film of oil is adequate. Daily inspections are mandatory.

g. Recoil mechanisms.

(1) Care of recoil mechanisms will be for the most part the same as for normal conditions. Using units must maintain their careful check as prescribed for ordnance publications. Should any difficulties arise, notify ordnance maintenance personnel immediately, as delaying notification may lead to further difficulties. At times the recoil mechanism may not function properly and the cycle of recoil may take longer than necessary. This is brought about by the oil becoming thick and not flowing as rapidly. As further firing is conducted, the mechanism gradually heats up the recoil oil and thins it out so that a normal cycle of time is then obtained. Do not condemn the recoil mechanism until definite proof of malfunction has been made. Should this condition arise, notify the ordnance maintenance personnel.

(2) **CRADLE AND GUN SLIDES.** Thickened or congealed lubricant increases this friction, shortens recoil, and retards counterrecoil. Heavy or congealed lubricants will be removed from all exposed parts of the rails and slides when the gun is retracted.

h. Equilibrators. Lubricate as prescribed in War Department Lubrication Order (fig. 72). The piston rod should be kept well lubricated to prevent formation of ice which would freeze it in posi-

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tion. It may be necessary to adjust nitrogen pressures to provide sufficient equalizing action. Upon return to temperatures above 0° F, gas pressure should be adjusted to the prescribed value.

i. Care and maintenance of top and bottom carriage.

(1) GEAR TRAINS.

(a) Extreme care should always be observed when lubricating the gear trains of the elevating and traversing mechanism. If care is not taken to follow lubrication instructions, malfunctions may require complete overhaul by ordnance.

(b) Condensation caused by rise in temperature must not be allowed to collect on shafts and bearings or it will result in the freezing of shafts where they enter the housing. **CAUTION:** *The importance of a light coat of lubricant on gear trains cannot be overemphasized.*

(c) Gear trains on all top carriages will be the most critical problem in lubrication. Winterization must be done by ordnance units as complete disassembly is required. Lubrication orders should be consulted for correct lubricant. When gear trains are winterized, only the bearings should be repacked and the gears coated. Additional lubrication must be sparing. Overlubrication will result in increasing handwheel effort to the point where operations will be hindered.

(2) BEARING SURFACE OF TOP CARRIAGE.

(a) Winterizing the bearing surface of the top carriage requires complete disassembly. Thorough removal of all old lubricant from bearing surface should be performed with dry-cleaning solvent. Be sure that all old lubricant is removed before applying prescribed lubricant. Use a light coat as overlubrication will result in difficult traversing.

(b) *Trunnion and trunnion seats.* Trunnion and trunnion seats should be given special attention. Bearings that are enclosed should be thoroughly cleaned. Lubricate sparingly, as overlubrication will result in difficult elevation.

(c) Make certain that drain holes provided in top and bottom carriage are kept open and that ice or snow is not permitted to gather inside the carriages.

j. Elevating and traversing arcs.

(1) Elevating and traversing arcs should be lubricated very sparingly. Snow will frequently collect on these parts. This will cake under pressure of the gears, forming ice which interferes with elevating and traversing. The snow must be removed by vigorous brushing with a stiff-bristle or wire brush before manipulation of the piece is attempted. Elevating and traversing arcs are difficult problems in heavy snowstorms. The importance of keeping them clean and protected as much as possible cannot be overemphasized.

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(2) At every opportunity during fire, the elevating rack should be inspected and cleaned of any snow that may have accumulated. After use, elevating rack should be thoroughly cleaned of oil and snow and relubricated.

(3) **INSPECTION OF TOP AND BOTTOM CARRIAGE.** Because of the small amount of lubricant used, inspection may be made daily to assure all parts having a coat of lubricant. Failure to follow this procedure will result in an unserviceable weapon.

k. Care and maintenance of bogie and limbers.

(1) **WHEEL BEARINGS.** Packing of wheel bearings must be done with the utmost care. A tendency to overpack them is predominant. This promotes freezing of wheels and prevents further travel of the weapon. When packing wheel bearings, make sure that they are first thoroughly cleaned with dry-cleaning solvent. Dry thoroughly before repacking. At no time leave any of the old lubricant on the bearings or any of the dry-cleaning solvent, as this contaminates the new lubricant that is being applied. **NOTE:** *Precaution must be taken not to handle the bearing with bare hands, as the moisture from the skin will corrode the bearings.*

(2) **CARE AND MAINTENANCE OF TIRES.**

(a) Special care of tires must be maintained in cold weather at all times. Check air pressure frequently and keep tread free of ice. Rubber becomes stiff in cold weather and is easy to damage. When a weapon is emplaced for a long time, tires will develop a flat surface at the point of contact with snow or frozen ground. Care should be maintained in traveling with the weapon that the speed be held at a minimum until the tire has regained its original shape.

(b) To avoid tires developing flat surfaces, it is a good policy to have the weapon bearing on its bottom carriage with the bogie wheels raised whenever it is inactive.

(c) Special care must also be maintained with air brakes. Rubber air hose becomes very brittle and careless handling causes them to break or crack. This must be avoided, as complete failure of the brakes will result. Sharp bends should be avoided.

(3) **CARE AND MAINTENANCE OF BRAKES.**

(a) **Air Brakes.** Drain air tanks of the weapon after use. This will blow out moisture formed by compressed air and will prevent freezing of lines and brakes. If brakes are frozen, notify ordnance maintenance personnel immediately. **CAUTION:** *Care should be maintained in connecting air hose to prime mover to prevent cracking or breaking when bends are too sharp.*

(b) **Mechanical brakes.** Care should be maintained that proper lubrication is applied to all connections and joints. Wheel chocks

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should be used in preference to setting brakes when the gun is parked. **CAUTION:** *When lubricating brake parts, keep lubricant away from inside of drums or shoes.*

(c) *Brake shoes.* Keep brake shoes as dry as possible. Make a thorough check of brake shoes whenever checking the wheel bearings.

30. HOT DRY CLIMATES.

a. In hot dry climates, inspect, clean, and lubricate more frequently than prescribed under normal operating conditions.

b. Clean and lubricate as soon as possible after firing or if there is any reason to expect corrosion to start.

31. SEVERE DUST OR SAND CONDITIONS.

a. If considerable dust or sand is present when the gun is operated, all lubricants on the traversing and elevating arcs and pinions should be removed. Lubricants contaminated with dust or sand are more harmful than no lubricant at all.

b. Clean thoroughly when firing is over, and relubricate.

32. HIGH HUMIDITY, EXTREME MOISTURE, AND SALT WATER.

a. Preservative lubricating oil (medium) will be used in lieu of engine oil at all temperatures above 0° F for application to all external unpainted metal surfaces, including the bore and breech and firing mechanism, on which a film of lubricant is maintained by manual application. Preservative lubricating oil (medium) will also be used for lubrication of oil can points for which engine oil is prescribed.

b. The bore of the tube and the breech mechanism should be kept heavily oiled and should be inspected daily for traces of rust.

c. In excessively salty conditions, the bore and breech mechanism should be inspected daily for traces of rust, and the oil should be changed often as the salt has a tendency to emulsify the oil and destroy its rust-preventive qualities.

33. REPORTS AND RECORDS.

a. **Reports.** If instructions are closely followed, proper lubricants used, and satisfactory results are not obtained, a report will be made to the ordnance officer responsible for the maintenance of the materiel.

b. **Records.** A complete record of seasonal changes of lubricants and recoil oil will be kept in the Artillery Gun Book for the materiel.

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Section X**DEMOLITION TO PREVENT ENEMY USE****34. GENERAL.**

a. The destruction of the materiel, subject to capture or abandonment in the combat zone, will be undertaken by the using arm only on authority delegated by the division or higher commander as a command function when such action is deemed necessary as a final resort to keep the materiel from reaching enemy hands.

b. Adequate destruction of artillery materiel means damaging it in such a way that the enemy cannot restore it to usable condition in the combat zone either by repair or by cannibalization. Adequate destruction requires that:

(1) Enough parts essential to the operation of the materiel must be damaged.

(2) Parts must be damaged beyond repair in the combat zone.

(3) The same parts must be destroyed on all materiel, so that the enemy cannot make up one operating unit by assembling parts from several partly destroyed units.

c. The tube and breech are the most vital parts of any piece of artillery. These are the first things to damage. After the tube and breech in importance come the recoil mechanism, sighting and fire control equipment, carriage, tires, gun book, and firing tables.

35. METHODS.**a. General.**

(1) The destruction procedures outlined are arranged in order of effectiveness. Destruction should be accomplished by method No. 1, if possible. If method No. 1 cannot be used, destruction should be accomplished by one of the other methods outlined, in the priority shown.

(2) Whichever method is used, the sequence outlined must be followed. Uniformity of destruction will then be obtained, whether or not the method is carried to completion.

(3) Certain of the methods outlined require special tools and materials, such as nitrostarch and incendiary grenades, which may not be items of issue normally. The issue of such special tools and material, the vehicles for which issued, and the conditions under which destruction will be effected are command decisions in each case, according to the tactical situation.

(4) **SIGHTS.** Detach all optical sights. If evacuation is possible, carry the sights; if evacuation is not possible, thoroughly smash the sights.

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b. Method No. 1 — destruction of tube, breech, and recoil mechanism.

(1) Open drain plug on recoil mechanism, allowing recoil fluid to drain. It is not necessary to wait for the recoil fluid to drain completely before firing the cannon in step (4), below.

(2) Place an armed (safety pin removed) antitank grenade M9A1, HE, or armed (safety pin removed) antitank rocket M6 in the tube with the nose end toward the rear. The grenade or rocket must be centered in the tube, using a wooden adapter. An alternate for the wooden adapter is the use of waste.

(3) Insert an unfuzed HE complete round or HE shell with propelling charge into the cannon and close the breech. Base-detonating HE shell cannot be used in this method.

(4) Fire the cannon, using a lanyard at least 100 feet long. The person firing should be under cover to the rear of the piece and approximately 20 degrees off the line of fire. Elapsed time: Approximately 2 to 3 minutes.

(5) The danger zone is approximately 500 yards.

c. Method No. 2.

(1) Insert TNT blocks in the bore, near the muzzle and in the chamber of the cannon. Close the breechblock as far as possible without damaging the safety fuse. Plug the muzzle tightly with earth to a distance of approximately 3 calibers from muzzle. Detonate the TNT charges simultaneously. Thirty to fifty half-pound blocks will be needed for effective demolition. If it is not possible to plug the bore, a larger number of TNT blocks will be needed for effective demolition.

(2) Ram an HE shell (without base fuze) into the forcing cone and place TNT blocks behind it, as specified above. Close the breechblock and detonate the TNT charge. A sufficient length of safety fuse should be used to permit personnel to reach safety zone or cover. The fuse may be routed through the primer hole in the spindle.

(3) Attention is invited to the fact that, for the larger calibers, the number of blocks to be used is an estimate not proved by tests.

d. Method No. 3.

(1) Place unfuzed incendiary grenades M14, on their sides, one on top of another, in the chamber. Close the breech. Equip another incendiary grenade with a 15-second safety fuse, ignite, and toss it in the muzzle. Quickly elevate the cannon to its maximum elevation. Elapsed time: 3 to 5 minutes. Six to eight grenades per cannon are required.

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(2) The metal from the grenades will fuse with the interior of the breechblock, making it impossible to open the breech.

e. Method No. 4.

(1) Fire adjacent guns at each other at point-blank range, using HE or AP shells. Two or more direct hits from a weapon of the same caliber, on a vital spot such as the breech mechanism, recoil mechanism, or tube should adequately destroy the artillery piece. Fire from cover. Danger space is from 200 to 250 yards.

(2) Destroy the last gun and carriage by the best means available.

(3) Danger from cannibalization is inherent in this method.

f. Ammunition. Instructions for demolition of ammunition are contained in TM 9-1901.

PART THREE — MAINTENANCE INSTRUCTIONS

Section XI

GENERAL

36. SCOPE. Part Three contains information for the guidance of the personnel of the using organizations responsible for the maintenance (first and second echelon) of this equipment. It contains information needed for the performance of the scheduled lubrication and preventive maintenance services, as well as description of the major systems and units and their functions in relation to other components of the equipment.

37. CLEANERS AND PRESERVATIVES. The following cleaning and preserving materials are required for use with this materiel. Additional information to that included in this manual with regard to use of these materials is contained in TM 9-850.

ALCOHOL, ethyl, grade 1	PAPER, flint
BRUSH, artist, camel's hair	PAPER, lens tissue
BURLAP, jute, 8 oz (40 in. wide)	REMOVER, paint and varnish
CHALK, white, railroad (1 x 4 in.)	SOAP, castile
CLEANER, rifle bore	SOAP, liquid, lens cleaning
CLOTH, abrasive, aluminum oxide	SOAP, saddle
CLOTH, crocus	SODA-ASH
CLOTH, wiping, cotton	SOLVENT, dry cleaning
NAPHTHALENE, balls	SPONGES, cellulose or natural
NEEDLE, sacking	TWINE, jute
OIL, neat's-foot	WASTE, cotton (2 grades, colored and white)
PALM, sailmaker's	

Section XII

SPECIAL ORGANIZATIONAL TOOLS AND EQUIPMENT

38. GENERAL. Following is a list of accessories issued per firing battery of 155-mm guns, mounted on the 155-mm gun carriage M1.

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
ADAPTER, S. (plug), oil filling, recoil mechanism, diam. hex. head $\frac{3}{4}$ in., over-all length $1\frac{1}{16}$ in.	70	41-A-26-500	—
CAP, oil screw filler (gun).....	70	41-C-395-625	—

*Where the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part Three — Maintenance Instructions

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
CHEST, oil pump, wood, S. reinforced, w/contents		41-C-738-540	For filling recoil system.
(Composed of:			
1 CHEST, oil pump, wood, S. reinforced, w/o contents, M16 (41-C-738-550)	70		
1 FUNNEL, copper, w/o strainer, cap. $\frac{1}{4}$ pt. (41-F-3580)	70		
1 HOSE, gasoline and oil, nonmetallic, high temp. resisting, complete w/couplings, length 120 in., ends threaded $\frac{1}{4}$ in.-18NPT and $\frac{1}{8}$ -27NPT (33-H-535)	70		
1 PUMP, hydraulic, oil M3 (11-P-575-300)	70		
1 RULE, S., flexible, length 30 cm, grad. one edge mm, other 64ths (41-R-2909)			
1 TUBE and CONNECTIONS, oil pump, M3 (44-T-3197)			
1 WRENCH, engrs., angle 15°, dble. head, open end, normal duty, alloy-S., size of opngs. $\frac{3}{4} \times \frac{13}{16}$ in. (41-W-1012))	70		
CHEST, tool, empty, metal, Ordnance design, w/o partitions, inside height, in. $11\frac{1}{16}$, inside width, in. $13\frac{1}{4}$, inside length, in. $28\frac{7}{8}$, material S.....	18	41-C-857-330	—
CHISEL, machs., hand, cold, width of cut $\frac{3}{4}$ in., length 8 in.	20	41-C-1124	—
CYLINDER, gas, filled, compressed gas, M1, O.D. $9\frac{1}{16}$ in., length $56\frac{3}{16}$ in.....	20	51-C-2255	For adj. equilibrator pressure.
DRIFT, brass, taper, diam. of pt. $\frac{7}{16}$ in., diam. $\frac{1}{2}$ in., length 4 in.	20	41-D-1530	—
DRIFT, brass, rd., taper, diam. of pt. $\frac{1}{2}$ in., diam. $\frac{3}{4}$ in., length 6 in.....	20	41-D-1533	—
FILE, A.S., hand, cut second, length point to shoulder 8 in...	20	41-F-1016	—
FILE, A.S., three square, cut smooth, length point to shoulder 6 in.....	20	41-F-1572	—

*Where the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part Three — Maintenance Instructions

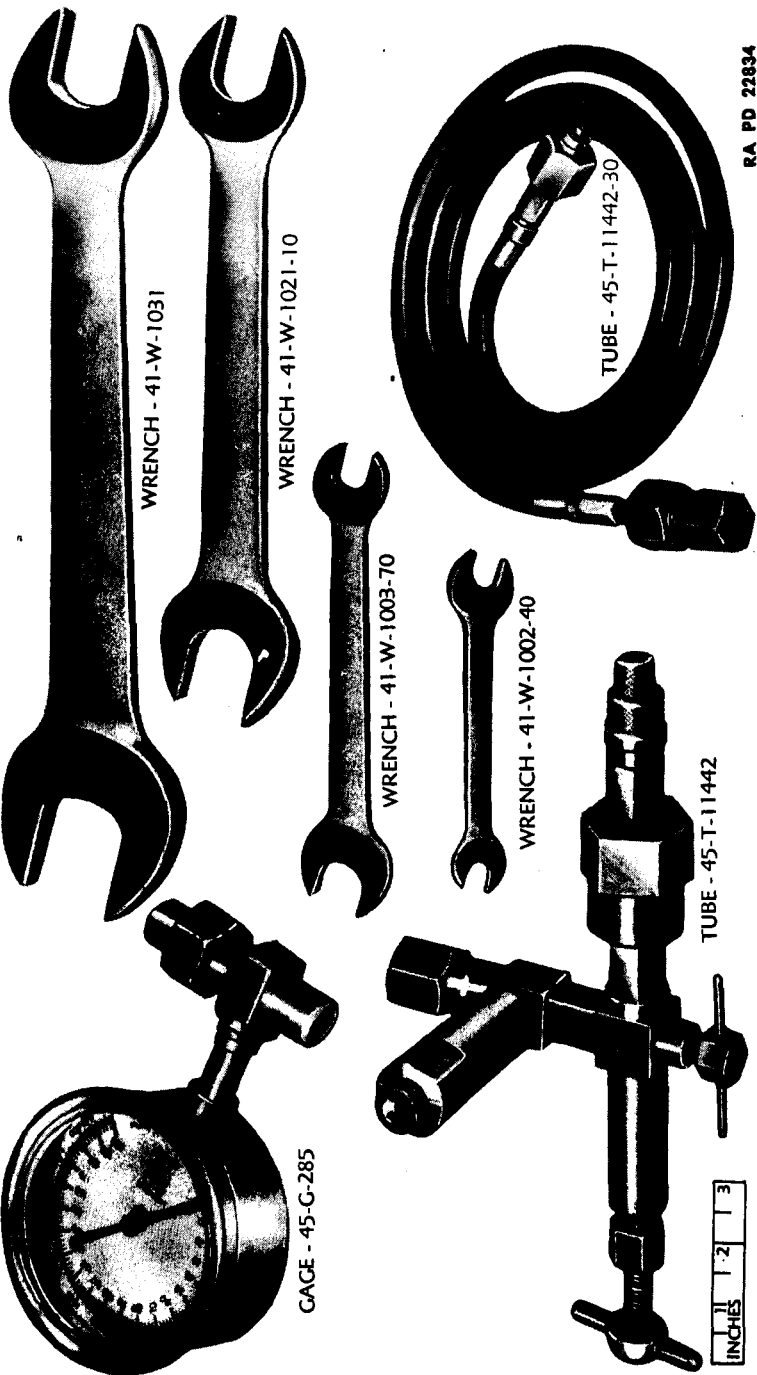


Figure 69 — Organizational Tools and Accessories

Part Three — Maintenance Instructions

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
GAGE, pressure, metal case, hydraulic, master assembly, size of dial $4\frac{1}{4}$ in., pressure 200 kg. (graduated in lbs, and in kg. per sq. cm).....	69	45-C-285	—
GAGE, tire pressure, piston type, balloon type, range 10 to 60 in one-lb. units, 60 to 160 in five-lb. units (sgle.-ft.)	21	8-G-357	—
HAMMER, hide faced, diam. of face $1\frac{3}{4}$ in., weight 2 lb.....	16	41-H-473	—
HAMMER, machs., ball peen, weight $\frac{1}{2}$ lb.....		41-H-521	—
HAMMER, machs., ball peen, weight $1\frac{1}{4}$ lb.....	20	41-H-524	—
HANDLE, file and tool, wood, med., diam. of hand grip $1\frac{1}{4}$ in.	20	41-H-1116	—
HANDLE, wheel bearing adj. and wheel stud nut wrench, diam. $\frac{3}{4}$ in., length 20 in.....	19	41-H-1541	Used w/socket wrench for wheel stud nuts.
HOSE, tire inflating complete w/single ft. chuck and air brake coupling, I.D. $\frac{1}{4}$ in., length 25 ft.....	71	33-H-986	—
PLIERS, side cutting, flat nose, length over-all 8 in.....	20	41-P-1977	—
PUNCH, drift, tapered, diam. $\frac{1}{4}$ in., length 10 in.....		41-P-3538	—
PUNCH, drive pin, standard, diam. of pt. $\frac{1}{8}$ in., over-all length 4 in.....	20	41-P-3602	—
PUNCH, drive pin, standard, diam. of pt. $\frac{1}{4}$ in., over-all length 4 in.....	20	41-P-3606	—
RELEASE, filling and drain valve		45-R-3649	—
RELEASE, gage, pressure, filling and drain valve.....	70	45-R-3650	—
ROLL, tool, canvas, empty, M4, size 26 x 30 in.....	20	41-R-2705-5	—
ROLL, tool, canvas, empty, M16, No. 4 cotton duck, $26\frac{1}{2}$ x $25\frac{3}{8}$ in., w/10 pockets, $1\frac{1}{2}$ to $3\frac{1}{8}$ in. deep.....	18	41-R-2705-41	—
SCREWDRIVER, common, normal duty, sgle. grip, length of blade 6 in., width of blade $\frac{5}{16}$ in.	20	41-S-1104	—

*Where the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part Three — Maintenance Instructions

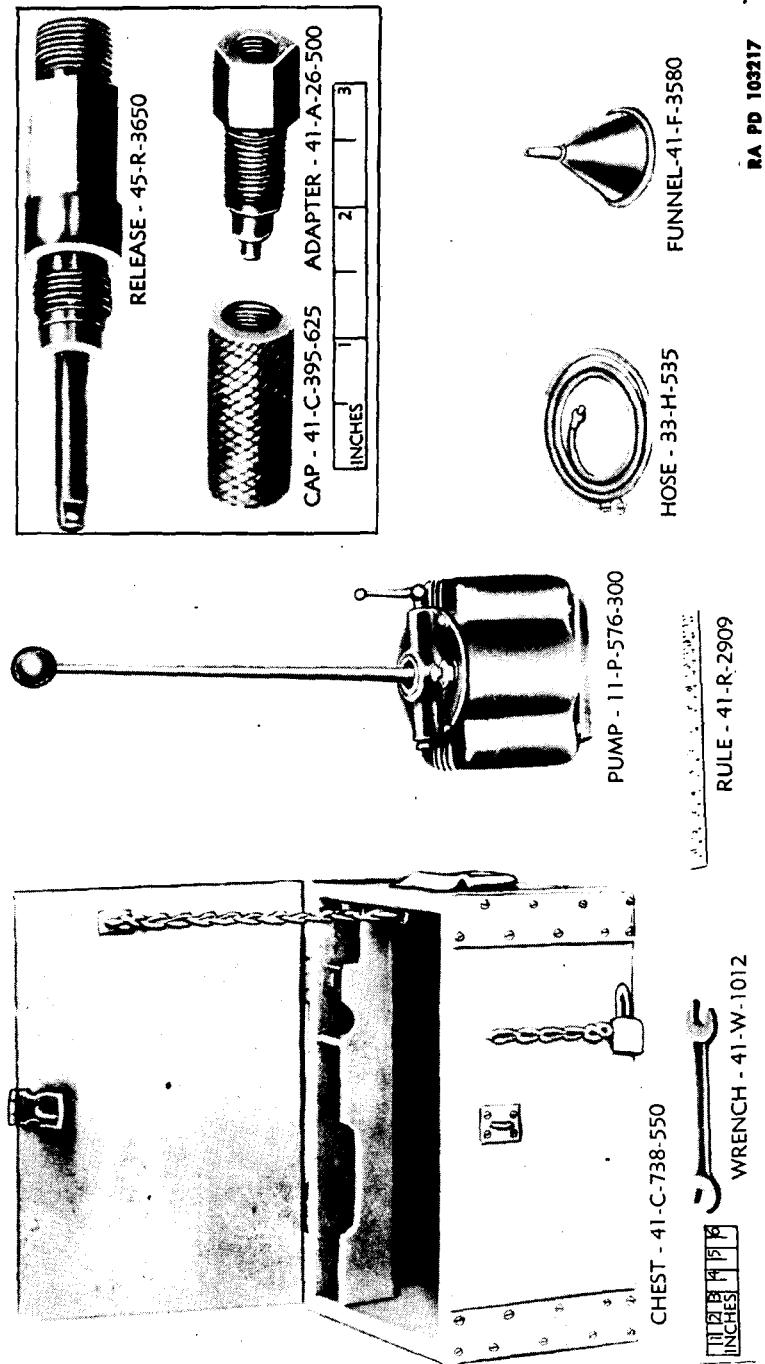
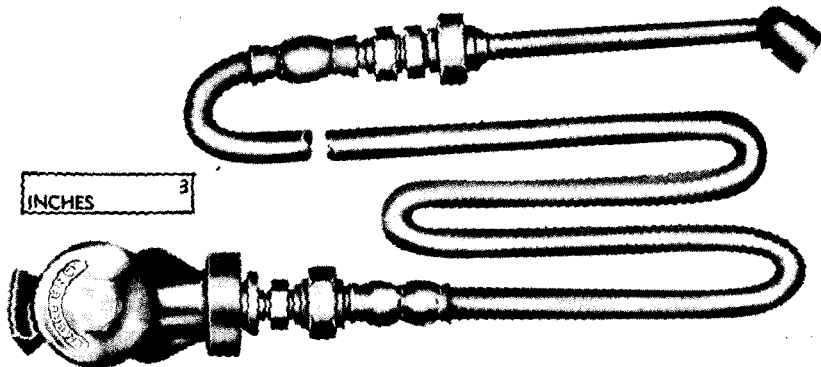


Figure 70 — Oil Pump Chest M16, w/Contents

RA PD 103217

Part Three — Maintenance Instructions



RA PD 61717

Figure 71 — Tire Inflating Hose (33-H-986)

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
SCREWDRIVER, machs., extra heavy duty, wood insert handle, length of blade 5 in., width of blade $\frac{1}{2}$ in.....	20	41-S-1385	—
TUBE, air filling, complete.....	69	45-T-11442	For adj. equilibrator pressure.
TUBE, air filling, copper, flexible, w/couplings	69	45-T-11442-30	For adj. equilibrator pressure.
WRENCH, engrs., angle 15° , dble. head, open end, normal duty, alloy-S., size of opngs. $\frac{1}{2} \times \frac{9}{16}$ in.....	69	41-W-1002-40	—
WRENCH, engrs., angle 15° , dble. head, normal duty, alloy-S., size of opngs. $\frac{1}{2} \times 1\frac{1}{16}$ in.	69	41-W-1003-70	—
WRENCH, engrs., angle 15° , dble. head, open end, normal duty, alloy-S., size of opngs. $\frac{3}{4} \times 1\frac{1}{16}$ in.....	70	41-W-1012	—
WRENCH, engrs., angle 15° , dble. head, open end, normal duty, alloy-S., size of opngs. $1\frac{5}{16} \times 1\frac{1}{16}$ in.....	69	41-W-1021-10	—
WRENCH, engrs., angle 15° , dble. head, open end, normal duty, alloy-S., size of opngs. $1\frac{1}{4} \times 1\frac{1}{16}$ in.....	69	41-W-1031	—
WRENCH, pipe strap, pipe cap. 1 to 5 in., length 18 in.....	19	41-W-1853	—
WRENCH, screw, monkey, knife handle, 8 in.	20	41-W-2341	—

*Where the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Part Three — Maintenance Instructions

Accessory	Fig. No.	Piece Mark or Fed. Stock No.	*Use
WRENCH, screw, monkey, knife handle, jaw opng. 3 in., length over-all 18 in.....		41-W-2345	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam. $\frac{3}{32}$ in., screw size set No. 10, cap No. 5-6.....	19	41-W-2449	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam. $\frac{1}{8}$ in., screw size No. $\frac{1}{4}$ in., cap No. 8, socket No. 10 flat		41-W-2450	—
WRENCH, set or cap screw (hollow head), hex., plug type, reg. short arm series, hex. diam. $\frac{3}{16}$ in., screw size set $\frac{3}{8}$ in., cap $\frac{1}{4}$ in.....	19	41-W-2452	—
WRENCH, socket, sgls. head, offset, sq-opng., size $\frac{1}{16}$ in.....		41-W-2850	—
WRENCH, wheel stud nut, dble. end hex. and sq-opngs., hex. opng. $1\frac{3}{64}$ in., sq-opng. 0.817 in., length $1\frac{7}{8}$ in.....	19	41-W-3838-30	Used w/HANDLE 41-H-1541, for wheel stud nuts.

*Where the accessory's use is not indicated, the nomenclature is self-explanatory or the accessory has general use.

Section XIII

LUBRICATION

39. LUBRICATION ORDER.

a. Reproduction of War Department Lubrication Order LO 9-350, figures 72 and 73, prescribes first and second echelon lubrication maintenance.

b. The lubricating fittings indicated on the order are illustrated in figures 74 to 78, showing their location on the materiel. The fittings shown in the figures may be identified on the order by the key numbers around the border.

c. A lubrication order (formerly War Department Lubrication Guide) is placed on, or is issued with, each item of materiel and is to be carried with it at all times. In the event the materiel is received without an order, a replacement should be immediately requisitioned (see FM 21-6)

Part Three — Maintenance Instructions

40. GENERAL LUBRICATION INSTRUCTIONS.

a. Lubricants are prescribed in the "Key" on the Lubrication Order in accordance with three temperature ranges, "above +32° F," "from +32° F to 0° F," and "below 0° F." The time to change grades of lubricants is determined by maintaining a close check on operation of the materiel during the approach to prolonged periods when temperatures will be consistently in higher or lower ranges. Because of the time element involved in preparing for operation at lower prevailing temperatures, a change to lubricants prescribed for a lower range will be undertaken the moment operation become sluggish. Ordinarily, it will be necessary to change lubricants *only when expected air temperatures will be consistently in the next higher or lower range*, unless malfunctioning occurs sooner due to lubricants being of improper consistency. NOTE: *Seasonal changes of lubricants and recoil oils will be recorded in the Artillery Gun Book.*

b. Service intervals specified are for normal operating conditions and continuous use of the materiel with frequent firing. Reduce these intervals under extreme conditions such as excessively high or low temperatures, prolonged periods of traveling or firing, continued operation in sand or dust, immersion in water, or exposure, or moisture. Any one of these conditions may quickly destroy the protective qualities of the lubricant, and require servicing in order to prevent malfunctioning or damage to the materiel.

c. Lubricating equipment.

(1) Be sure to clean lubricating equipment both before and after use. Operate lubricating guns carefully and in such manner as to insure proper distribution of the lubricant. If lubrication fitting valves stick and prevent the entrance of lubricant, remove the fitting and determine cause. Replace broken or damaged lubricators. If lubricator cannot be replaced immediately, cover hole with tape as a temporary expedient to prevent the entrance of dirt. If oil lines become clogged, disassemble the line and remove the obstruction.

(2) Lubrication fittings, grease cups, oilers, oil holes, and plugs are circled in red for ready identification.

(3) Wipe lubricators and surrounding surfaces clean before applying lubricant. Where relief valves are provided, apply new lubricant until the old lubricant is forced from the vent. Exceptions are specified in notes or on the lubrication order. Metal surfaces on which a film of lubricant must be maintained by manual application, will always be wiped clean before the film is renewed.

d. Cleaning.

(1) Unless otherwise specified, use rifle bore cleaner or dry-cleaning solvent to clean or wash all metal parts, whenever partial or total disassembly is undertaken or when renewing the protective film

Part Three — Maintenance Instructions

WAR DEPARTMENT LUBRICATION ORDER **LO 9-350** 18 FEBRUARY 1945 (Supersedes WDLO No. 10, 4 August 1944)

GUN, 155-mm, M1 AND M1A1, M2 CARRIAGE, GUN, 155-mm, M1 LIMBER, CARRIAGE, HEAVY, M2 AND M5

References: ORD 7 SNL D-24, TM 9-350, TM 9-1350

Clean fittings before lubricating. Lubricate after washing.
Intervals are based on actual operation under normal conditions. Reduce intervals under extreme dust, sand, heat or humid conditions. Extend when not in use.

To clean parts, use SOLVENT, dry cleaning or Oil-fuel, Diesel. Dry before lubricating. For exceptions, see Gun Bore and Breech and Firing Mechanism Notes.
Lubricate dotted arrow points on both sides. Opposite points are shown by short arrows.

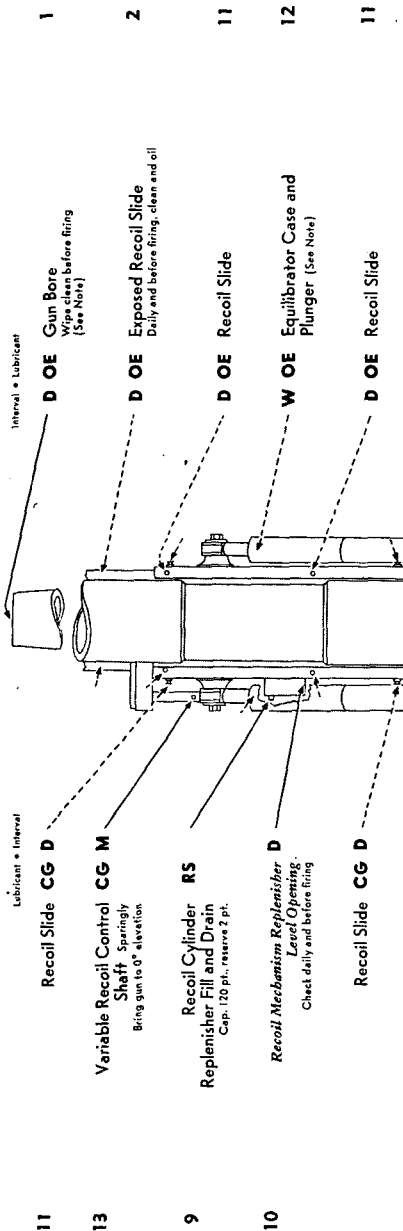


Figure 72 — Reproduction of War Department

Part Three — Maintenance Instructions

NOTES

BREACH AND FIRING MECHANISM—Immediately after firing, and on 3 consecutive days thereafter, disassemble the gas check pad from the obturator and firing mechanism, M1, except the gas check pad with bore swabbing solution. Rinse with clean water, dry thoroughly and oil. Daily, when the gun is not being fired, clean with SOLVENT, dry cleaning, wipe dry and oil. Daily and immediately after firing, the firing lock, M17 will be cleaned with SOLVENT, dry cleaning, wiped thoroughly dry and oiled. At time of disassembly, wipe the gas check pad clean (do not use dry cleaning solvent or bore swabbing solution). Apply a film of OE (SAE 30) above +32°F, or (SAE 10) below +32°F, prior to re-assembly.

EQUILIBRATOR CASE AND PLUNGER—With gun at 0° elevation, uncrew cover from front of equilibrator and slide toward narrow end of case. Wipe moisture from all surfaces and apply a thin film of lubricant to all exposed parts including outer surface of both plunger and case.

GUN BORE—Immediately after firing and on 3 consecutive days thereafter, swab with solution of 1/2 pound of SODA ASH to each gallon of warm water. Rinse with clean water, dry thoroughly and oil. Daily, when not being fired, renew the oil film—every 5 days, clean with SOLVENT, dry cleaning, wipe dry and oil.

KEY

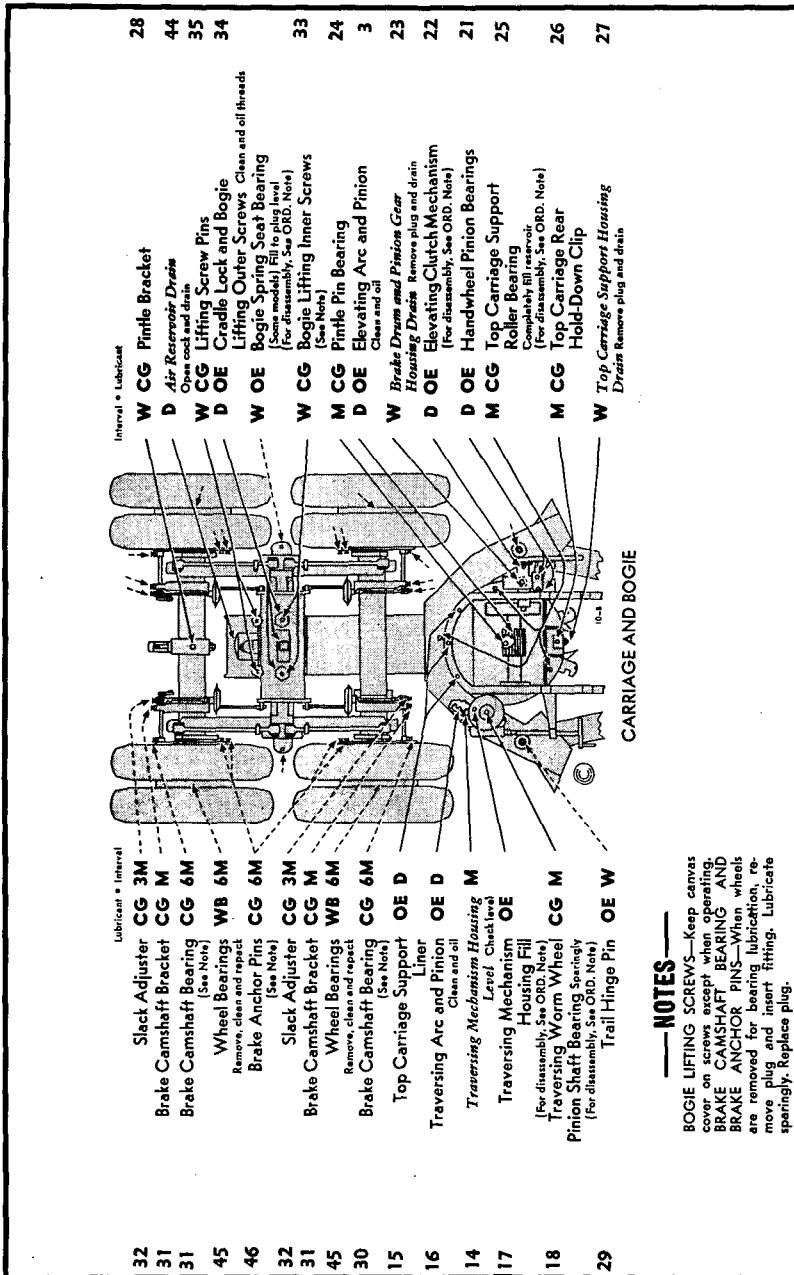
LUBRICANTS	LOWEST ANTICIPATED AIR TEMPERATURE		LUBRICANTS	INTERVALS
OE—OIL engine	above +32°F	+32°F, to 0°F	WB—GREASE, general purpose No. 2	D—Daily
CG—GREASE general purpose	SAE 30	SAE 10	PS—OIL, recoil special	W—Weekly
	No. 1	No. 0	PS—OIL, lubricating, preservative, special	M—Monthly
				3M—3 months
				6M—6 months

11 D OE Recoil Slide
11 D OE Recoil Slide
11 D CG Recoil Slide
19 D OE Equilibrator Guide Slides
20 D OE Equilibrator Guide Adjusting Screw Clean and oil
42 RS Recupertor Cylinder Reserve Oil Filling Valve Cap 2 pt.
43 D Recupertor Cylinder Oil Index Check daily and before firing
7 D OE Breech Hinge Pin
5 D OE Breech Crankshaft Bearing
4, 6 D OE Breech and Firing Mechanism (See Note)
8 D OE Obturator Spindle

RA PD 102379

*SEE PARAGRAPH 58

Part Three — Maintenance Instructions



NOTES

BOGIE LIFTING SCREWS—Keep canvas cover on screws except when operating.

BRAKE CAMSHAFT BEARING AND BRAKE ANCHOR PINS—When wheels are removed for bearing lubrication, remove plug and insert fitting. Lubricate spring. Replace plug.

Figure 73 — Reproduction of War Department

Part Three — Maintenance Instructions

LIMBER M2 LIFTING SCREW — Loosen locking pin, raise lock and partially fill chamber.

OIL CAN POINTS—Weekly lubricate. **MIL** Limber Base and Trail Bearing Supports. **MIL** Limber Latch; **M5** Limber Eye Bolt Hinges and Hatches; **M5** Limber Eye Bolt Anchor Pin, Clamp Bolt Hinges with OE. **DO NOT LUBRICATE**—Springs, Limber Spring Pins, Bogie Torque Arm.

PERSONNEL GUIDANCE—Read the Maintenance Guide. **PERSONNEL**—Variable Recoil Gearings, Balanceings, Cordle Trunnion Gearings, Elevating Clutch Mechanism Yoke, Elevating Brake Drum Shaft Bearings, Elevating Hand-wheel Gear and Pinion, Elevating Shaft Bearings, Elevating Shaft Gear and Pinion, Traversing Mechanism Housings, Traversing Worm Wheel Pinion Shaft Lower Shaft Bearings, Covering Handwheel Shaft Bearings, Limber Trail Bearings, Trust Bearings, Bogie Spring Seat Bearings (not fitted with oil plugs).

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 18 February 1945.

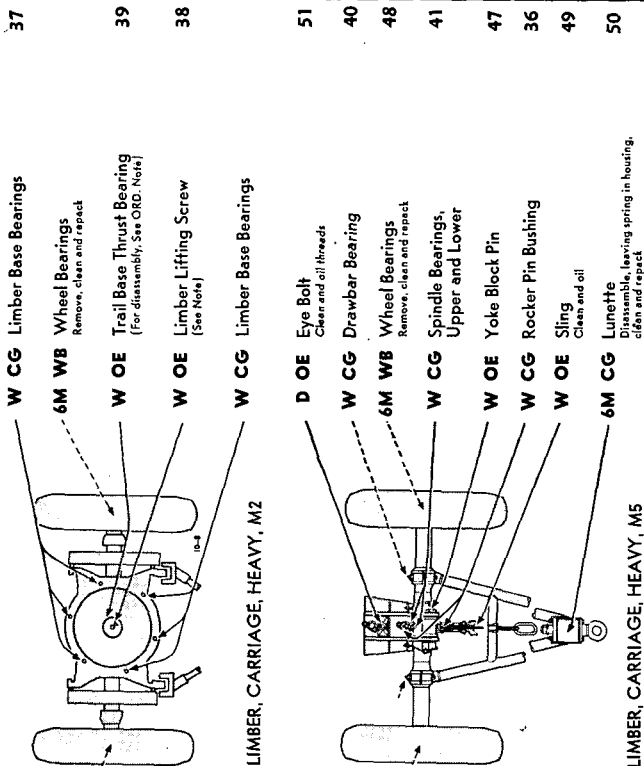
[A.G. 300.8 (18 February 1945)]

BY ORDER OF THE SECRETARY OF WAR:
G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

ULIO,
Major General,
The Adjutant General.

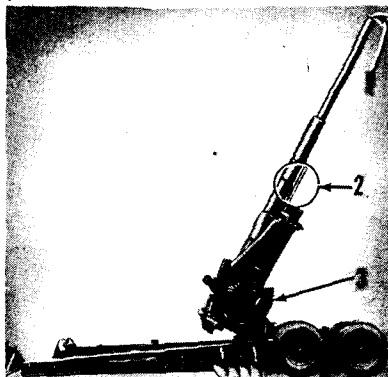
LO 9-350



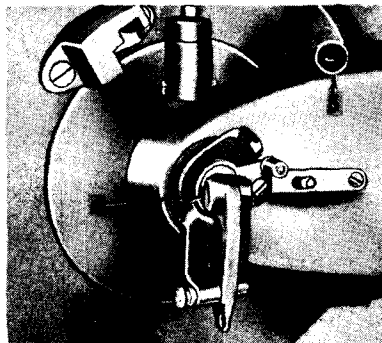
Requisition additional Lubrication Orders in conformance with instructions and lists in FM 21-6

RA PD 102380

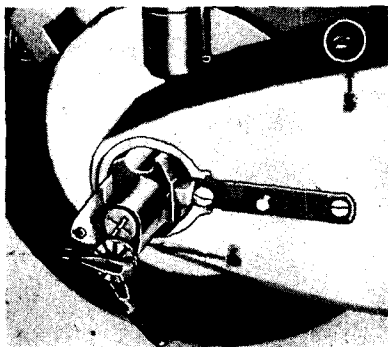
Part Three — Maintenance Instructions



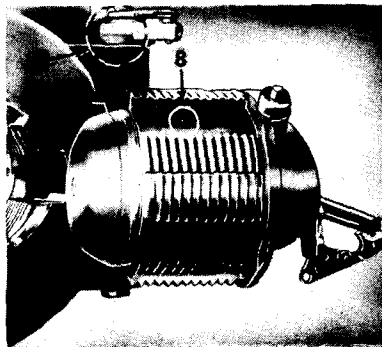
- 1 — GUN BORE
- 2 — EXPOSED RECOIL SLIDE
- 3 — ELEVATING ARC AND PINION



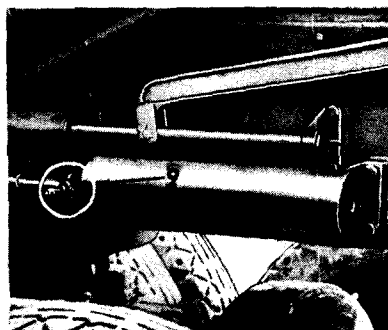
- 4 — BREECH AND FIRING MECHANISM
- 5 — BREECH CAMSHAFT BEARING



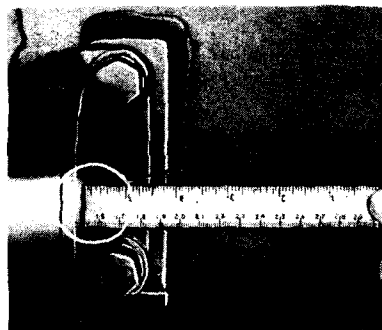
- 5 — BREECH CRANKSHAFT BEARING
- 6 — BREECH AND FIRING MECHANISM



- 7 — BREECH HINGE PIN
- 8 — OBTURATOR SPINDLE



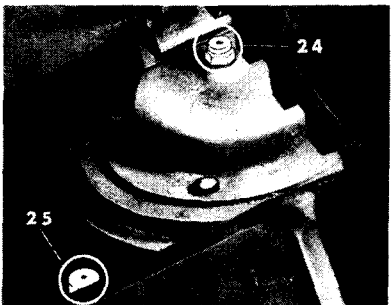
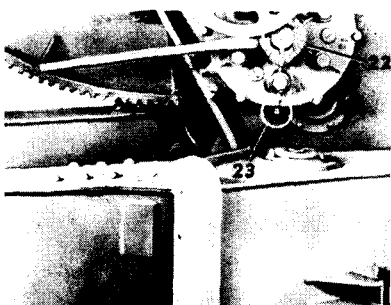
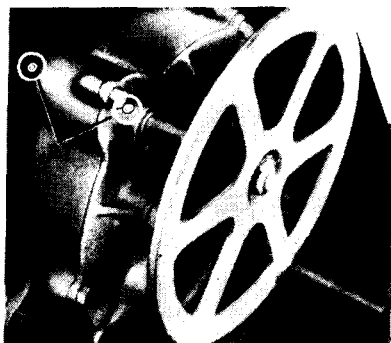
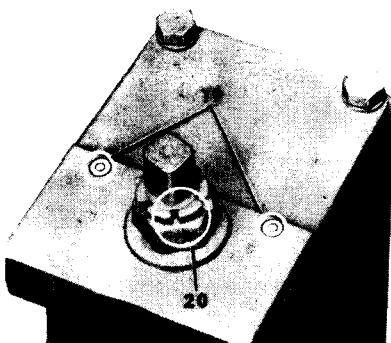
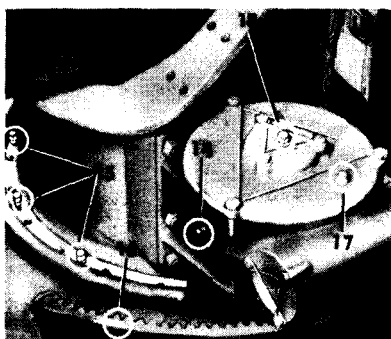
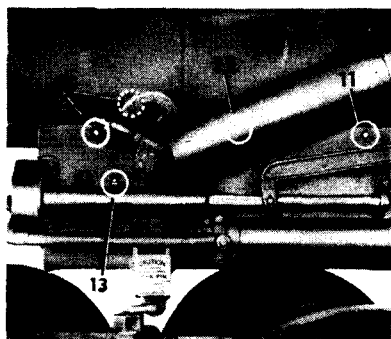
- 9 — RECOIL CYLINDER REPLENISHER FILL AND DRAIN



- 10 — RECOIL MECHANISM REPLENISHER LEVEL OPENING

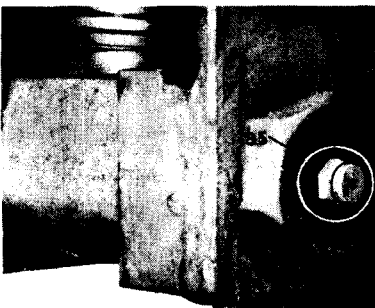
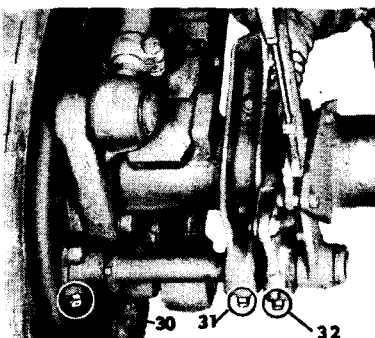
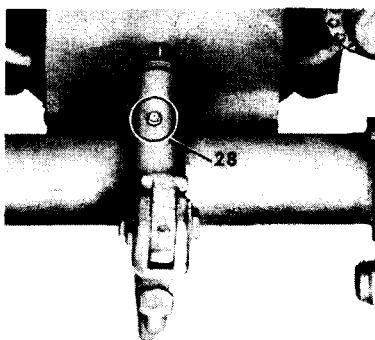
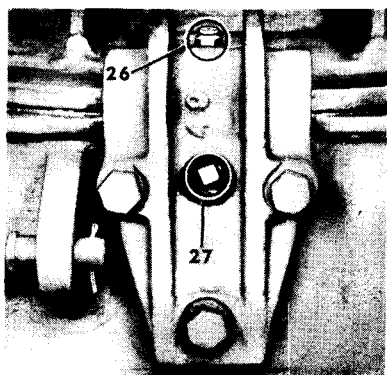
RA PD 102374

Figure 74 — Lubricating Points, Nos. 1 to 10 Inclusive

Part Three — Maintenance Instructions

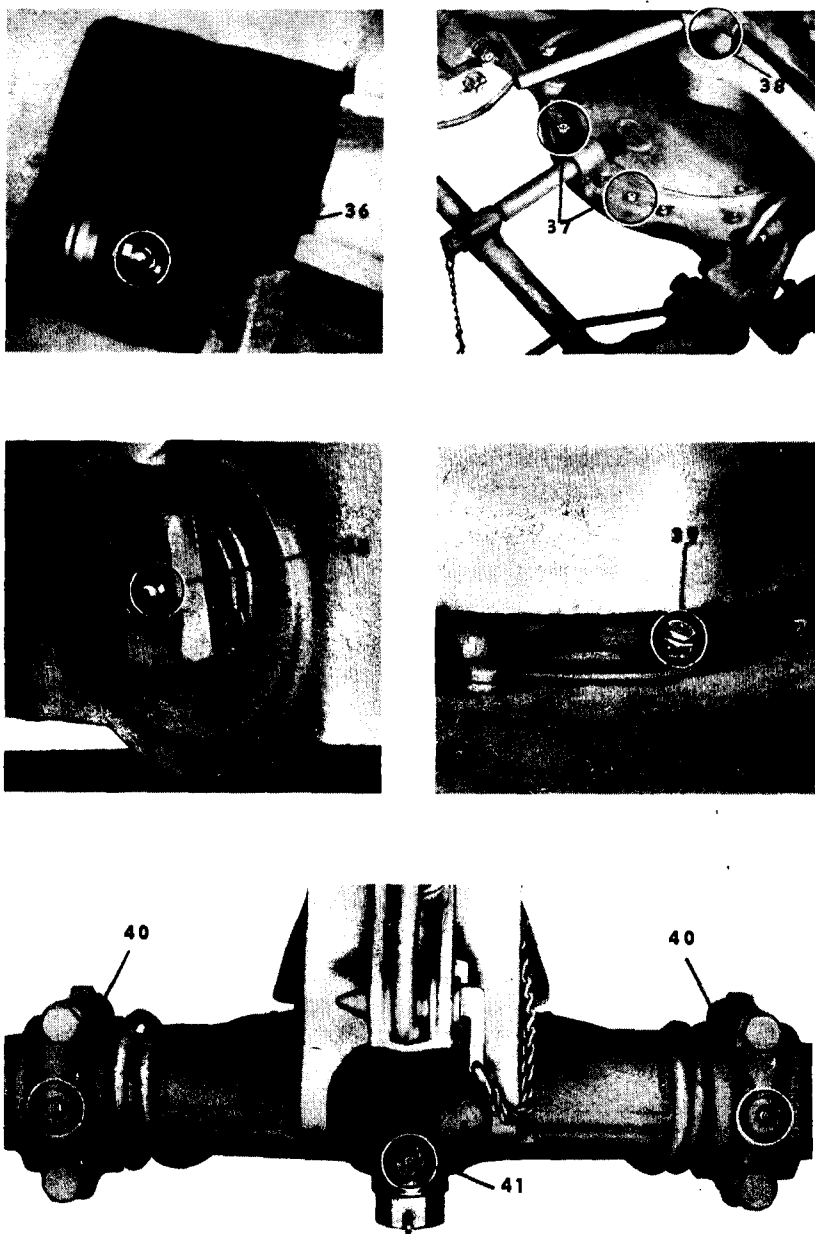
RA PD 102375

Figure 75 — Lubricating Points, Nos. 11 to 25 Inclusive

Part Three — Maintenance Instructions

RA PD 102376

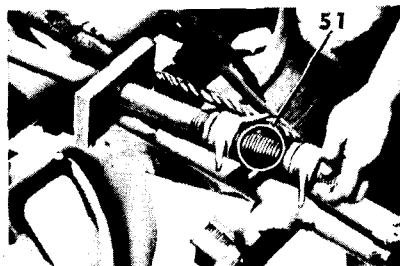
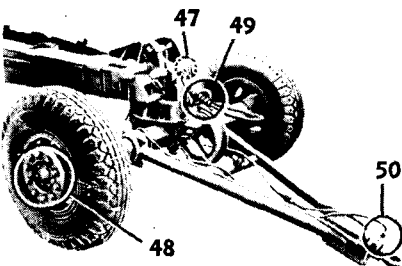
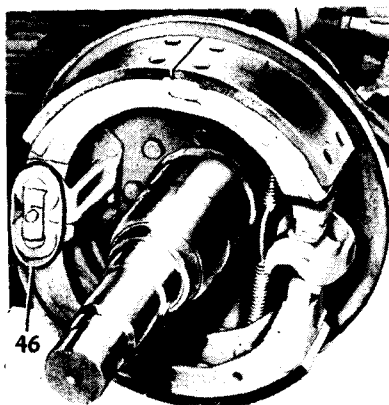
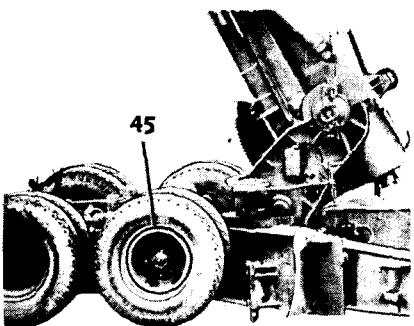
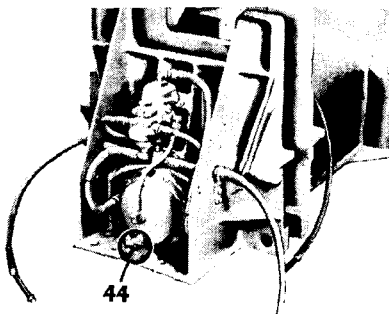
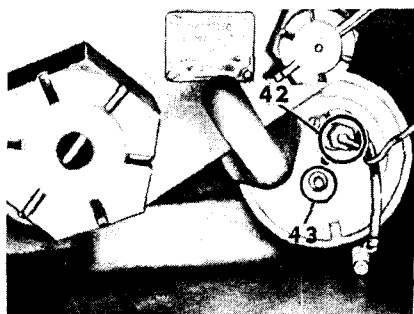
Figure 76 — Lubricating Points, Nos. 26 to 35 Inclusive

Part Three — Maintenance Instructions

RA PD 102377

Figure 77 — Lubricating Points, Nos. 36 to 41 Inclusive

Part Three — Maintenance Instructions



RA PD 102378

Figure 78 — Lubricating Points, Nos. 42 to 51 Inclusive

Part Three — Maintenance Instructions

on exposed metal surfaces. Flushing of gear cases and bearing housings will not be undertaken unless inclosed mechanism is first disassembled in order to insure complete removal of the cleaner or solvent prior to application of lubricants. Use of gasoline for cleaning is prohibited. Dry all parts thoroughly before lubricating.

(2) Care must be taken when cleaning oil and grease compartments to insure the complete removal of all residue or sediment. Dirt or other foreign matter should not be allowed to drop into any of the lubricating compartments.

e. Preservative lubricating oil (medium).

(1) Preservative lubricating oil (medium) contains inhibitors which provide excellent protection against rust and corrosion on metal surfaces for short periods. The viscosity (grade) is comparable to engine oil (SAE 30).

(2) When engine oil (SAE 30) is prescribed by War Department Lubrication Orders and Technical Manuals for oiling bores, breech and firing mechanisms, and other points lubricated by oil can, or by wiping with a cloth wrung out in oil, preservative lubricating oil (medium) will be submitted therefor under the following conditions:

- (a) Landing operations.
- (b) Salt air areas.
- (c) High humidity.
- (d) Excessive moisture conditions, especially when prescribed daily lubrication service cannot be performed regularly.

CAUTION: *Preservative lubricating oil (medium) will not be used in gear cases or other internal mechanisms unless so prescribed by applicable War Department Lubrication Orders or Technical Manuals nor will it be used below +32° F in lieu of engine oil (SAE 10) or preservative lubricating oil (special or light).*

Section XIV

PREVENTIVE MAINTENANCE SERVICE

41. GENERAL.

a. Preventive maintenance services prescribed by Army Regulations are a function of using organization echelons of maintenance. This section contains preventive maintenance service allocated to crew and scheduled preventive maintenance service allocated to (second echelon) organizational maintenance.

b. Incidents of wear, breakage, cleaning, and inspection make necessary the occasional disassembly of various parts of the gun and carriage. This work comes under two headings; that which may be performed by the battery personnel with the equipment furnished and that which must be performed by trained ordnance personnel.

Part Three — Maintenance Instructions

c. The battery personnel may, in general, do such dismounting as is required for the assembling of parts indicated for battery use. Such work should be done in the manner prescribed herein. Any difficulty which cannot be overcome by the prescribed method must be brought to the attention of ordnance maintenance personnel.

d. The battery personnel will not attempt to disassemble any part of the materiel not authorized in this manual.

42. COMMON PROCEDURES.

a. The use of wrenches which do not fit snugly on the parts must be avoided. They will not only fail to tighten the part properly, but will damage the parts being tightened, and there is a danger of spreading the wrenches and rendering them useless.

b. Bolts should be coated with white lead before the nuts are assembled to them.

c. Dirt and grit settle on bearing surfaces and, in combination with the lubricants, form a cutting compound. Powder fouling attracts moisture and hastens the formation of rust. It is essential that all parts be kept clean. If rust should accumulate, its removal requires special care in order that clearances shall not be unduly increased. Crocus cloth should be used for this purpose; the use of coarse abrasives is forbidden. In disassembly, assembly, or inspection, extreme care must be exercised to prevent dust, dirt, or other foreign matter from entering mechanisms of the gun and carriage.

d. Oilcups, lubricating fittings, oilholes and fill, level, and drain plugs should be marked with a circle about three-quarters of an inch in diameter. The circle is to be painted red in order that the lubricating point may be readily located. The fittings themselves should not be painted.

e. In disassembly, assembly, and inspection, extreme care must be exercised to prevent dust, dirt, and other foreign matter from entering mechanisms of the gun and carriage. Keep the materiel clean. Clean parts such as bearings, slide surfaces, threads, etc. thoroughly and lubricate before assembling. Never use a steel hammer on any part of the gun or carriage. If a copper, rawhide, or lead hammer is not available, use a block of wood as a buffer.

f. The breech and muzzle covers should be used when traveling, or when the gun is not in service. When the gun is inactive for a considerable length of time, the gun and carriage should be prepared for storage as described in section XXX.

Part Three — Maintenance Instructions

g. Should enemy shell burst near the weapon or after the gun has been under fire, it must be determined that the weapon has not been damaged to a dangerous degree before further use. Damage of serious nature should be reported to the ordnance officer.

h. Tires requiring repairing or treading will be replaced with serviceable tires. Any oil, grease, gasoline, or kerosene which comes in contact with tires under any circumstances will be washed immediately.

i. Water must not be played from a high-pressure hose on any part of the gun or carriage. Washing should be done with a sponge and water. Carefully dry parts which have become wet during washing, and then oil the parts in manner prescribed in section XIII.

43. PREVENTIVE MAINTENANCE SCHEDULES.**a. Daily service.**

Point	Preventive Maintenance	Detailed Instructions
Gun, carriage and limber as a unit.	Inspect over-all for general appearance. The materiel should be clean, and painted and lubricated properly. Examine all exposed unpainted surfaces for signs of rust. Check over-all for cracked, damaged or broken parts.	WDLO 9-350
Gun tube.	Note condition of bore. Look for erosion at the origin of rifling, bruises in the gas check seat, burs or roughness on the leveling plates. Remove rust from leveling plates with crocus cloth. Clean gun bore and powder chamber. Wipe dry and recoil.	WDLO 9-350 and par. 58
Firing mechanism or firing lock.	Test the firing mechanism by firing two primers. The primers should necessarily extend more than one-eighth of an inch out of the obturator spindle plug when pressed in hard with finger or thumb. Ream out the primer seat if necessary. Examine the mechanism closely for signs of rust, as the closely finished surfaces of the firing mechanism rust very easily. Repair or replace parts of the firing mechanism which may be worn or broken. Keep well lubricated. Note the action of the firing mechanism by pulling on the lanyard. Action should be positive.	WDLO 9-350 and sections XVIII and XIX.

Part Three — Maintenance Instructions

Point	Preventive Maintenance	Detailed Instructions
Breech mechanism as a unit.	<p>Note smoothness of operation of the breech mechanism in opening and closing. If the mechanism binds or does not operate smoothly, disassemble, clean, examine the parts for wear or breakage, and replace unserviceable parts. Lubricate the mechanism and reassemble. If it is still difficult to operate, notify ordnance maintenance personnel.</p> <p>Examine the breechblock and breech recess for burrs, indentations on the threads, rust, pitting, and other evidence of erosion. If not possible to smooth or clean with crocus cloth, notify ordnance maintenance personnel. Do not use any other abrasive.</p> <p>Examine the breechblock carrier assembly, the machined surface on which the breechblock rotates, and hinge pin for a roughened or scored condition. Remove roughness or scores with crocus cloth.</p> <p>Examine obturator spindle for burrs. If possible, smooth the spindle using crocus cloth; if not possible notify ordnance maintenance personnel.</p> <p>Examine the split rings for burrs or cracks. Replace the defective rings.</p> <p>Examine gas check pad for bruises or torn covering. Replace defective pad.</p> <p>Inspect for proper functioning. Open and close the breech several times to make sure that it functions properly. Examine closely for signs of rust, as the closely finished surfaces of the breech mechanism rust very easily. Keep well lubricated.</p>	WDLO 9-350 and section XVII
Breech hinge pin.	Lubricate.	WDLO 9-350
Breech crank shaft bearing.	Lubricate.	WDLO 9-350
Obturator spindle.	Clean the face of the obturator spindle and ream the obturator spindle vent hole.	Par. 62
Counterbalance assembly.	Test the mechanism to see that it functions properly at different degrees of elevation. If out of adjustment, notify ordnance maintenance personnel.	Par. 59
Recoil and counter-recoil piston rod nuts.	Make certain the recoil and counter-recoil piston rod nuts are fully engaged and pinned.	Par. 17
Recoil mechanism.	Inspect for leakage at recoil rod and counterrecoil rod stuffing boxes.	Par. 55
Recoil slides and guides.	Clean and lubricate. Inspect closely for scores, bruises or pitting.	WDLO 9-350 and par. 52
Recoil mechanism replenisher piston.	Check position of replenisher piston.	Pars. 56 and 79

Part Three — Maintenance Instructions

Point	Preventive Maintenance	Detailed Instructions
Recoil cylinder oil index.	Check position of oil index.	Par. 54 and 76
Wipers.	See that the front gun rail wipers and upper and lower rear gun rail wipers are in good position so that they will prevent dust or sand from entering the slides of the recoil mechanism.	—
Equilibrator slide guides.	Clean and lubricate.	WDLO 9-350
Equilibrator guide adjusting screw.	Clean and lubricate.	WDLO 9-350
Elevating arc and pinion.	Clean and oil.	WDLO 9-350
Elevating clutch mechanism.	Inspect for proper functioning.	Par. 15
Elevating hand-wheel pinion bearing.	Lubricate.	WDLO 9-350
Top carriage support.	Lubricate.	WDLO 9-350
Traversing arc and pinion.	Clean and oil.	WDLO 9-350
Cradle lock.	Clean and oil.	WDLO 9-350
Bogie lifting outer screws.	Clean and oil.	WDLO 9-350
Air reservoir drain.	Open and drain.	WDLO 9-350 and par. 84

b. Before firing.

Point	Preventive Maintenance	Detailed Instructions
Gun tube.	Wipe off excess lubricant from exposed gun tube.	—
Gun bore.	Wipe the bore dry with clean, dry bur-lap or wiping cloth.	—
Firing mechanism or firing lock.	Check for proper functioning.	Sections XVIII and XIX
Recoil and counter-recoil piston rod nuts.	Note that these nuts are fully engaged and pinned.	Par. 17
Recoil mechanism replenisher piston.	Check position.	Par. 79
Recoil cylinder oil index.	Check position.	Par. 76
Recoil slides and guides.	Clean and lubricate.	WDLO 9-350
Recoil indicator.	Set to "ON" position.	Par. 16
Elevating mechanism.	Check for proper functioning.	Par. 15
Equilibrator.	Check setting of equilibrator temperature adjusting scale.	Par. 81
Traversing mechanism.	Check for proper functioning.	Par. 15

Part Three — Maintenance Instructions

Point	Preventive Maintenance	Detailed Instructions
Carriage, trails and spades.	After the weapon is in firing position, but before firing, make certain that the carriage is emplaced firmly, the trails are properly spread and the spades set securely in position.	Section VII

c. During firing.

Point	Preventive Maintenance	Detailed Instructions
Gun bore.	Whenever the rate of fire permits, examine the bore for powder fouling. Clean with bore brush if necessary.	Par. 58
Firing mechanism.	Check between rounds for proper functioning. Clean and lubricate.	Sections XVIII and XIX
Breech mechanism	Whenever the rate of fire permits, remove powder fouling from the primer seat and primer vent. Wash powder fouling from the face of the obturator spindle.	Par. 62
Recoil indicator.	The length of recoil should be measured for the first several rounds and then at regular intervals during firing. Figures 95 and 96 show the limits of allowable recoil of the gun at all elevations, for muzzle velocities of 2,100 feet per second and 2,800 feet per second, when operated at normal temperatures of the recoil oil (70° F). For the first round fired and at other temperatures, the length of recoil may not be within the limits shown in the illustrations. However, if the length of recoil does not fall within the desired limits when the gun is operated at normal temperatures, ordnance maintenance personnel should be notified.	—
Recoil cylinder oil index.	Check position.	Par. 76
Recoil mechanism replenisher piston.	Check position.	Par. 79
Carriage, trails and spades.	Make certain that the carriage is firmly emplaced at all times, and that the spades and trails are absorbing the shock of recoil properly.	Section VII

d. After firing.

Point	Preventive Maintenance	Detailed Instructions
Gun bore.	Clean and oil.	Par. 58
Firing mechanism.	Clean and oil.	WDLO 9-350
Breech mechanism.	Clean and oil.	WDLO 9-350
Equilibrators.	Clean.	WDLO 9-350
Recoil mechanism.	Inspect over-all.	Section XX
Recoil indicator.	Set to "OFF" position.	Par. 16
Recoil cylinder oil index.	Check position.	Par. 76

Part Three — Maintenance Instructions

Point	Preventive Maintenance	Detailed Instructions
Recoil mechanism replenisher piston.	Check position.	Par. 79
Elevating mechanism.	Inspect over-all.	—
Traversing mechanism.	Inspect over-all.	—
Carriage.	Inspect carriage for condition. When damaged, notify ordnance maintenance personnel. Clean carriage thoroughly.	WDLO 9-350
Brakes.	Inspect.	Par. 84
Wheels and tires.	Inspect.	Par. 83

e. Weekly service. Perform all daily service as listed above and in addition the following:

Point	Preventive Maintenance	Detailed Instructions
Equilibrator case and plunger.	Inspect and service.	WDLO 9-350
Trail hinge pin pin- tle bracket.	Inspect and service.	WDLO 9-350
Lifting screw pins.	Inspect and service.	WDLO 9-350
Bogie spring seat bearing.	Inspect and service.	WDLO 9-350
Bogie lifting inner screws.	Inspect and service.	WDLO 9-350
Brake drum and pinion gear housing drain.	Inspect and service.	WDLO 9-350
Top carriage support housing drain.	Inspect and service.	WDLO 9-350

(1) HEAVY CARRIAGE LIMBER M2.

Point	Preventive Maintenance	Detailed Instructions
The limber as a unit.	Note the general appearance and condition.	—
Lifting mechanism.	Note ease of operation of the limber lifting mechanism. Examine the lifting mechanism center screws for burrs or scores. Note that the lifting screw functions smoothly through its full length of travel, and does not bind.	Par. 86
Trail base and lifting mechanism lock.	Note that the trail base swivels smoothly and that the lifting mechanism lock functions without binding.	Par. 86
Axle.	Check the spring shackle and lifting mechanism base pins.	Par. 86
Locking pins.	Note ease of operation of the various locking pins, handles, handwheels, etc., and that they perform their proper function without underbinding.	Par. 86

Part Three — Maintenance Instructions

Point	Preventive Maintenance	Detailed Instructions
Wheels.	Note condition of tires, tubes, tire air valve, disks, and rims. Check disk and rim nuts for tightness. Check disk and rim studs for body bruises or scored threads.	Par. 83 and 86
Air line clips.	Check for broken or loose air line clips.	Par. 86

(2) HEAVY CARRIAGE LIMBER M5

Drawbar bearing.	Inspect and service.	WDLO 9-350
Spindle bearings upper and lower.	Inspect and service.	WDLO 9-350
Yoke block pin.	Inspect and service.	WDLO 9-350
Rocker pin bushing.	Inspect and service.	WDLO 9-350
Sling.	Inspect and service.	WDLO 9-350

f. **Monthly.** Inspect and make certain that all previously scheduled preventive maintenance operations have been performed.

Point	Preventive Maintenance	Detailed Instructions
Variable recoil control shaft.	Inspect and service.	WDLO 9-350
Brake camshaft bracket.	Inspect and service.	WDLO 9-350
Traversing mechanism housing.	Inspect and service.	WDLO 9-350
Traversing worm wheel.	Inspect and service.	WDLO 9-350
Pintle pin bearing.*	Inspect and service.*	WDLO 9-350
Top carriage support roller bearing.	Inspect and service.	WDLO 9-350
Top carriage rear hold-down clip.	Inspect and service.	WDLO 9-350
Slack adjuster.	Inspect and adjust.	Par. 84
Heavy carriage limber M2 as a unit.	Inspect and service.	WDLO 9-350
Heavy carriage limber M5 as a unit.	Inspect and service.	WDLO 9-350

g. **Semi-annually.** Inspect and make certain that all previously scheduled preventive maintenance operations have been performed.

Point	Preventive Maintenance	Detailed Instructions
Brake camshaft bearing.	Inspect and service.	WDLO 9-350
Wheel bearings.	Assemble, clean and repack.	Par. 83
Brake anchor pins.	Inspect and service.	WDLO 9-350
Lunette.	Inspect and service.	WDLO 9-350

*In order to lubricate the pintle pin bearing properly and to prevent interference with the elevating pinion, remove the straight lubricating fitting from the pintle bolt cover and replace it with an elbow type lubricating fitting.

*Part Three — Maintenance Instructions***h. Before traveling.**

Point	Preventive Maintenance	Detailed Instructions
Gun bore.	Open the breech and make certain the gun bore is clean; close the breech.	—
Traveling locks.	Make certain that the cradle lock is locked and that the traveling lock is in position on trails.	Par. 23
Piston rod nuts.	After the gun is retracted and the tube is locked to the traveling lock, make sure the piston rod nuts are replaced on the piston rods.	Par. 23
Front spades.	Make certain the front spades are inserted in their proper positions on the trails for traveling and that the spade keys are put in place.	Par. 23
Trails.	Make sure the trails are raised and properly clamped to the limber for traveling.	Par. 23

Section XV**MALFUNCTIONS AND CORRECTIONS**

44. GENERAL. A malfunction is an improper or faulty action of some part, or parts of the weapon that may result in a stoppage or failure to fire.

45. FAILURE TO FIRE.**a. Failure to fire with the firing lock M17.**

(1) If the gun fails to fire, make two more attempts to fire. After the last attempt, wait at least 60 seconds and open the firing lock. If the percussion element on the primer has been struck solidly, replace the primer and continue firing.

(2) If the percussion element of the primer is struck lightly, disassemble the firing lock and clean thoroughly with dry-cleaning solvent. Relubricate lightly and reassemble the lock.

(3) If trouble still is not remedied, disassemble the lock and examine the firing spring and pin. If the spring is weak, replace. If the point on the firing pin is deformed, replace the pin.

b. Failure to fire with firing mechanism M1.

(1) If the gun fails to fire, make two more attempts to fire. After the last attempt, wait at least 60 seconds and remove the firing mechanism. If the percussion element of the primer is struck solidly, replace the primer and continue firing.

(2) If the percussion element of the primer is struck lightly and trouble may be that the lanyard was not pulled hard enough, replace the primer and pull the lanyard with considerable snap.

Part Three — Maintenance Instructions

(3) Disassemble the firing mechanism and replace the firing pin if deformed. If firing pin is not deformed, clean all parts with dry-cleaning solvent. Dry thoroughly and relubricate lightly.

(4) The firing mechanism may not be screwed fully home. Make sure that the firing mechanism is screwed as far beyond the latch as possible.

c. Gun fails to fire after primer has discharged.

(1) If the primer is heard to fire and gun does not fire, the vent-hole through the obturator spindle may be fouled or damp. Wait at least 60 seconds and remove the primer.

(2) The charge may be damp. Remove the propelling charge and replace.

(3) The propelling charge may be inserted wrong in the chamber. Examine the charge and make sure that the igniter end (red end) of the charge is facing the breechblock.

d. Primer does not discharge. If the primer does not discharge, it is due to one of the following reasons.

(1) **WEAK PULL ON THE LANYARD.** Pull lanyard with considerable snap.

(2) **FIRING MECHANISM M1 NOT SCREWED HOME.** Adjust the firing mechanism so the primer seats properly.

(3) **BROKEN, BENT, OR FOULED FIRING PIN.** Remove firing mechanism and disassemble. Wash all parts free from dirt or gummed oil with rifle bore cleaner. Dry thoroughly and lubricate with seasonal grade engine oil. Replace broken parts.

(4) **DEFECTIVE PRIMER.** Insert new primer and continue firing.

46. BREECH MECHANISM DOES NOT OPERATE FREELY.

a. If the breech mechanism does not operate freely, disassemble breech mechanism. Clean all parts thoroughly and relubricate lightly. Examine the breechblock and breech recess threads for burrs and scores. If any are present, notify ordnance maintenance personnel.

b. If the breechblock closes hard at high angles of firing, the counterbalance may be improperly adjusted. Adjust (par. 59).

c. Breechblock does not open (seized breechblock). Tap the rear of the breechblock with brass hammer at the same time have a man exert a reasonable pull on the breech operating lever. If this fails, insert a long 4- x 4-inch timber (wrapped with burlap to protect the bore) down the muzzle end of the tube and at the same time have a man exert a reasonable pull on the breech operating lever. If this fails to relieve the seized breechblock, notify ordnance maintenance personnel. If the breechblock seizes when the weapon is loaded, do not use the timber, but notify ordnance maintenance personnel.

Part Three — Maintenance Instructions

47. GUN RETURNS TO BATTERY WITH TOO GREAT A SHOCK.

a. The gun returning into battery with too great a shock may be caused by either insufficient oil in the replenisher, excess oil in the counterrecoil mechanism, change of viscosity of oil due to rapid firing, or a broken replenisher spring.

b. Refill the replenisher (par. 79) and drain the reserve oil off and refill to normal (par. 80). Allow mechanism to cool before continuing firing. If this malfunction is not then correct notify ordnance maintenance personnel.

48. GUN OVERRECOILS.

a. The gun overrecoiling (figs. 95 and 96) may be caused by insufficient oil in the recoil cylinder, insufficient gas pressure in the recuperator, or by malfunction of the variable recoil mechanism.

b. Refill the replenisher (par. 79). If action is not normal then notify ordnance maintenance personnel.

49. GUN UNDERRECOILS.

a. If the gun underrecoils, the recoil mechanism may not be warmed up and the oil too thick. The gun will recoil normally after a few rounds.

b. Clean and lubricate the tube bearing surface. If the bearing surface is scored, notify ordnance maintenance personnel.

50. GUN WILL NOT RETURN TO BATTERY.

a. When the gun does not return to battery it may be caused either by insufficient oil in the counterrecoil system or insufficient gas pressure.

b. Drain off and refill the oil reserve. If this does not correct the action notify ordnance maintenance personnel.

51. GUN SLOW TO RETURN TO BATTERY WHEN OIL INDICATION IS NORMAL. This condition is caused by insufficient gas pressure or excess friction in the packings and cannot be corrected in the field; notify ordnance maintenance personnel.

52. UNEVEN OR JERKY RECOIL ACTION.

a. This condition may be caused by air having been admitted into the oil, lack of lubrication, or scoring on the gun slides and cradle guides. Evidence of air present is noticeable by foaming or frothing of the oil when it is bled from the recoil cylinder.

b. If there is evidence of air in recoil cylinder, notify ordnance maintenance personnel. Inspect, clean, and lubricate the gun slides and cradle guides.

Part Three — Maintenance Instructions

53. NO SOUND OF AIR ESCAPING FROM AIR RELIEF VALVE IN COUNTERRECOIL HEAD DURING COUNTERRECOIL.

a. The air relief valve in the counterrecoil cylinder front head may become rusted shut, collect foreign matter under the seat and prevent closing, have broken valve spring or scored seat. Remove and clean the air relief valve.

b. Remove set screw. Remove the guide, valve spring, valve, and valve housing from the counterrecoil cylinder front head. Clean and replace broken or damaged parts. Reassemble the relief valve back in the head taking care to assemble parts in their proper order. The counterrecoil cylinder front head should not be removed to clean or repair the relief valve.

54. OIL INDEX REMAINS STATIONARY WHEN THE RESERVE IS PUMPED IN AGAINST EVIDENT PRESSURE. The packing is too tight, or the index is broken or locked by some foreign substance. Drain off all reserve oil and refill. While injecting the oil, tap the oil index gently with each stroke of the pump. If the oil index fails to move after approximately 300 strokes of the pump, refer the matter to ordnance maintenance personnel.

55. OIL LEAKAGE.

a. Oil may be observed to leak from around the recoil rod or counterrecoil rod stuffing boxes. Reestablish the correct amount of oil in the replenisher (par. 79) and drain and reestablish the proper oil reserve (par. 80). If oil has to be replaced in the replenisher and if the oil reserve has to be reestablished so often that it interferes with normal function of the weapon, notify ordnance maintenance personnel.

b. **Oil leaks from rear of replenisher.** Whether or not a serious leak exists must be determined by the position of the replenisher piston and the frequency of refilling required in the recoil system. There is no cause for alarm should the oil drip rapidly from the rear of the replenisher when the gun is elevated, provided the cradle has been at a minimum elevation on the carriage for some time previously. If oil continues to drip, notify ordnance maintenance personnel.

c. **Oil leaks from forward end of counterrecoil cylinder.** Black oil appearing in front of the counterrecoil piston is a normal condition due to lubrication. Clear oil is an indication of a leak due to broken packing springs or lack of compression on the spring. Report leak of clear oil to ordnance maintenance personnel.

d. **Excessive leaks from recuperator and recoil filling and drain valve.** Sticking of valve or defective packing. Report to ordnance maintenance personnel.

Part Three — Maintenance Instructions

56. POSITION OF REPLENISHER PISTON DOES NOT CHANGE DURING CONTINUED FIRING. Replenisher piston stuck. Drain oil from replenisher through filling and drain release. Remove plug at breech end of replenisher. Insert a block of hardwood in the rear of the replenisher against the piston end, and tap with a hammer. Refill the replenisher. (If piston does not move as oil is pumped in, notify ordnance maintenance personnel.) Drain oil again. If piston moves toward muzzle end of replenisher, refill as prescribed in paragraph 79. If piston does not move, notify ordnance maintenance personnel. If a gun in the hands of the using arms is not being fired, the replenisher should be exercised as described above, at least once a month. There are two 0.08-inch (2-mm) holes in the replenisher piston guide and one 0.12-inch (3-mm) hole in the replenisher cylinder, which are for the purpose of draining the cylinder of accumulated water and oil that has passed the replenisher piston and to provide for the circulation of air through the replenisher. The two holes in the piston guide are in the center of the teat wrench holes. The cylinder hole is in the underside of the replenisher about 1¼ inches from the rear end. It is very important that these holes be kept open. They can be cleaned with a small copper wire. The walls of a replenisher should never be struck with a hammer or any other article. If the replenisher cylinder becomes dented in any way, report the fact to ordnance maintenance personnel.

57. MALFUNCTION OF BRAKES.

a. Brakes fail to operate.

(1) Source of air supply may be shut off at prime mover. Open output cocks in air lines at rear of prime mover.

(2) Reservoir drain cock may be open. Close drain cock on reservoir.

(3) Dirt in the air lines may lodge in the diaphragm seats and obstruct proper seating, causing leakage of air from the relay valve and emergency valve exhaust parts. Air is exhausted from these parts only when the brake pedal of the prime mover is being moved. Serious leakage of air from these parts can be heard; small leakage can be detected by smearing soap suds over the parts. Refer to ordnance maintenance personnel.

(4) The air line hose couplings may be loose or damaged or the air lines may leak. Tighten loose couplings. Test for leaks with soap suds. If damage is discovered in air line tube, hose, or couplings, refer to ordnance maintenance personnel.

b. Brake runs hot.

(1) The slack adjuster may be improperly adjusted. Adjust brakes (par. 84).

Part Three — Maintenance Instructions

(2) Brake parts may be broken or deformed. Refer to ordnance maintenance personnel.

(3) Dirt or rust on linkage may cause air brake to drag and run hot. Clean and lubricate air brake linkage.

c. Slow brake application of slow release.

(1) The slack adjuster may be out of adjustment causing travel of chamber push rod. Adjust brakes (par. 84).

(2) The air filters may be dirty. Clean air filters (par. 84).

(3) The air tubing may be dented or the air hose may be kinked. Straighten kinked air hose but, if air tubing or hose is damaged, refer to ordnance maintenance personnel.

(4) Dirt or rust on linkage may retard action of the air brake. Clean and lubricate air brake linkage.

d. Weak braking action.

(1) The brake lining may be worn, glazed, or greasy. Refer to ordnance maintenance personnel.

(2) The slack adjuster may be improperly adjusted. Adjust brakes (par. 84).

(3) The air lines between the air reservoir and the brake push rod diaphragm chamber may be restricted. Refer to ordnance maintenance personnel.

e. Intermittent braking.

(1) Over-lubrication of anchor pins, camshaft, or wheel bearings may cause the brake lining to become greasy. Refer to ordnance maintenance personnel.

(2) Slack adjuster may be improperly adjusted. Adjust brakes (par. 84).

(3) The brake drum may be scored. Refer to ordnance maintenance personnel.

(4) The wheel bearings may have excessive bearing play. Refer to ordnance maintenance personnel.

f. Brakes do not release.

(1) The air line hose may be improperly connected to the prime mover. Connect the hose coupling marked "SERVICE" to the service (left) air line coupling on the prime mover and the hose coupling marked "EMERGENCY" to the emergency (right) air line coupling on the prime mover.

(2) Cut-out cocks in the air lines at the rear of the prime mover may be closed. Open the cut-out cocks.

(3) Air line tubing or hose may be restricted. Check all tubing and hose. If damaged tubing or hose is discovered, refer to ordnance maintenance personnel.

Part Three — Maintenance Instructions

(4) Dirt or rust on linkage may cause failure of air brake to release. Clean and lubricate air brake linkage.

g. Dragging brakes.

(1) Slack adjuster may be improperly adjusted. Adjust brakes (par. 84).

(2) The brake push rod diaphragm springs may be defective. Refer to ordnance maintenance personnel.

(3) Dirt and rust may cause air brake to drag. Clean and lubricate the air brake linkage.

Section XVI

TUBE AND BREECH RING

58. GENERAL.

a. The using arm personnel are not permitted to do repair work on the tube or breech ring.

b. The 155-mm gun is fitted with longitudinal gun slides and bearing strips. A recoil scale is fastened to the right-hand side rail. The interior surface of the breech recess is threaded to receive the breechblock. An extension on the underside of the breech ring forms a recoil lug by means of which the gun is connected to the recoil mechanism. A hook on the underside of the recoil lug is used for retracting the gun from firing position to the traveling position. Leveling plates that include finished seats for the gunner's quadrant are set in the breech ring.

c. Maintenance. The bore should be cleaned as soon as possible after firing. The purpose of cleaning after firing is to remove all powder fouling and all traces of residue and primer salts which cause corrosion. The purpose of cleaning on subsequent days is to remove all evidence of sweating. A clean bore has a uniform gray appearance; do not attempt to obtain a bright, polished finish. Do not try to remove copper fouling. Swab the bore with one of the solutions mentioned below, and in order of preference as listed. Use swab of burlap wound around the end of the bore cleaning brush.

(1) RIFLE BORE CLEANER, IF AVAILABLE.

(a) Thoroughly clean after firing, *when the tube has cooled sufficiently to touch with the bare hand*, and for 2 consecutive days thereafter, with undiluted cleaner. Make sure all surfaces, including the rifling, are well coated, but do not wipe dry. On the third day after firing, clean the bore again with rifle bore cleaner. If the weapon will probably be fired within the next 24 hours, do not wipe dry; but

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if it will not be fired within that time, wipe dry and coat with the prescribed oil.

(b) When the piece is not being fired, renew the oil film daily. Every 5 days, clean the bore with rifle bore cleaner, wipe dry, and reoil.

NOTE: *When necessary to conserve the supply, the cleaner may be diluted up to 50 percent with water without reducing the cleaning action materially, provided prevailing temperatures are above +32° F. However, when the product is diluted, the rust-preventive qualities are so reduced that the surfaces cleaned must be dried thoroughly and oiled.*

(2) **SODA-ASH.**

(a) Swab the bore immediately after firing, *while the tube is still hot*, and daily thereafter on the following 3 days, with a solution of ½ pound of soda-ash to each gallon of warm water. When all powder fouling has been removed, rinse with clear water, dry thoroughly with clean burlap, and oil.

(b) When the piece is not being fired, renew the oil film daily. Every 5 days, clean the bore with dry-cleaning solvent, wipe dry, and reoil.

(3) **WHITE CASTILE SOAP OR ISSUE SOAP.** Prepare a solution by shaving 1 pound of soap into 4 gallons of water (preferably warm water, to dissolve the soap more readily) and follow the same procedure as in (2), above.

CAUTION: *When issue soap is used, special care must be taken to rinse the bore thoroughly after cleaning, because the soap may contain free caustic which will cause corrosion if not removed completely.*

(4) **HOT WATER.** As a temporary measure after firing, the bore may be cleaned by swabbing with quantities of hot water while the bore is still hot. Dry the bore thoroughly after cleaning and coat with oil immediately, to prevent rusting. As swabbing with hot water may not remove all the primer salts or powder residue, clean the bore as soon as possible thereafter by one of the preferred methods in (1), (2), or (3), above.

Section XVII

BREECH MECHANISM

59. GENERAL.

a. The breech end of the gun or powder chamber is opened for loading and closed and sealed for firing by means of the breech mechanism. The carrier-supported breechblock is the principal part of the breech mechanism. The associated mechanisms with their related

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parts are: the breech operating mechanism, obturator mechanism, counterbalance and firing mechanism (figs. 79 and 80).

(1) The principal part of the breech operating mechanism is the breechblock operating lever. By means of this lever the breech mechanism is rotated from its fully locked to its fully unlocked position. The breech mechanism is then swung out of the breech recess leaving the powder chamber clear for loading. After loading the breech mechanism is swung around on its carrier into the breech recess and rotated and locked in its fully closed position by means of the breechblock operating lever and its actuated parts.

(2) The obturator mechanism (fig. 81) is housed in the breechblock. The obturator mechanism seals the breech, thereby preventing the rearward escape of the powder gases. As the powder charge is ignited, the pressure against the spindle head compresses the gas check pad, expanding it and the split rings to effectively seal the rear of the powder chamber. The obturator assembly used with the firing mechanism M17 is the same as that used with the firing mechanism M1 except for the spindle plug. *NOTE: There are two types of gas check pads which may be issued for use with this materiel. The old type pads consisted of a dense rubber-like compound encased in a wire mesh and asbestos covering. The new gas check pad are solid Neoprene rubber containing no metal or asbestos covering.*

(3) The counterbalance mechanism (fig. 85) is provided to facilitate opening the breech, to provide greater ease in closing the breech mechanism, particularly at greater angles of elevation, and also to hold the breechblock back to keep the breech fully open for loading. The counterbalance mechanism compensates for the effect of gravity in the operation of the breech mechanism, thereby making it easier to open and close. Some early models are equipped with a regulating device as an extension of the hinge pin. By rotating the counterbalance regulating screw, the tension of the spring can be increased or decreased to suit the angle of fire.

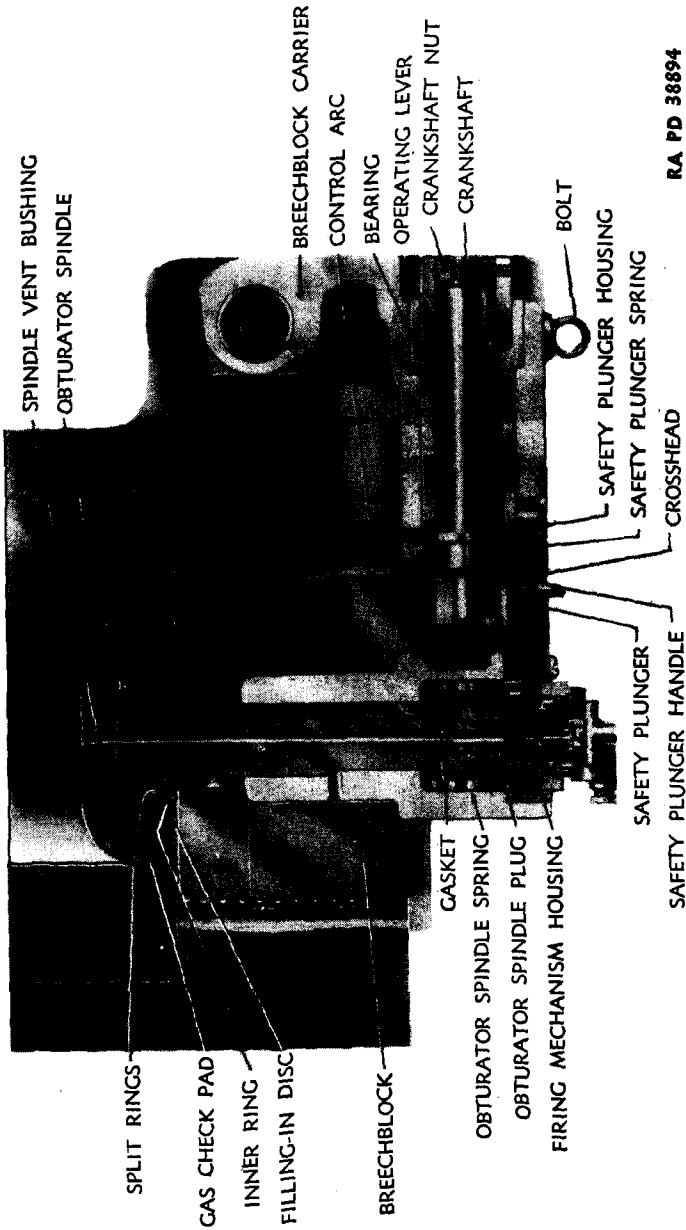
(4) Through the action of the lanyard operating firing mechanism attached to the firing mechanism housing in the breechblock, the firing pin is actuated and strikes the primer, thereby firing the piece.

60. DISASSEMBLY OF BREECH MECHANISM.

a. **Remove firing mechanism safety plunger housing assembly.** With the firing mechanism removed and the breech open, remove the two screws and washers which secure housing assembly to carrier, using a scribe or thin-bladed knife; push detent away from lock, turn lock to left and withdraw it. Remove safety plunger housing assembly.

b. **Remove firing mechanism receiver housing assembly and obturator spindle assembly.** Unscrew and remove firing mechanism

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RA PD 38894

Figure 79 — Breech Mechanism — Sectional View

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receiver housing assembly while holding mushroom-head against breechblock. Push obturator spindle back through the carrier with a hammer handle. Withdraw obturator spindle, split rings, inner ring, gas check pad, and filling-in disk from breechblock. Remove spring from carrier. **CAUTION:** *Never unscrew firing mechanism receiver housing assembly from its position on rear end of obturator spindle until breech has been opened.*

c. **Remove breechblock assembly.** Remove screws from arc and breech ring. Remove arc. Slide a wood pole, 1¾-inch diameter by 4 feet long, through the breechblock. With one man holding the pole and another working the operating lever up and down, and at the same time pushing the breechblock back on the pole, remove the breechblock. Carefully lift the breechblock (on pole) away from the breechblock carrier.

d. **Remove operating lever assembly.** Remove pin from breechblock operating lever bearing retaining bolt and remove bolt. Work operating lever up and down easily, and, at the same time, pull out on operating lever to remove crosshead. Swing the carrier to closed position and withdraw operating lever, bearing, and crankshaft from carrier.

e. Replace all damaged and worn parts replaced in first and second echelon, and refer to higher authority for replacement of other worn or damaged parts. Clean and lubricate.

61. ASSEMBLY OF BREECH MECHANISM.

a. Install operating lever assembly.

(1) Lubricate outside surface of operating lever bearing and bearing opening in breechblock with oil. Slide operating lever assembly into opening in breechblock carrier and swing carrier to open position.

(2) Lubricate crankshaft and crosshead, and slide crosshead into position on crankshaft, with flat side of crosshead toward crankshaft. Push operating lever all the way into position.

(3) Lubricate body of breechblock operating lever bearing retaining bolt, and push bolt into position in carrier and operating lever. Secure with pin.

b. **Install breechblock assembly.** **NOTE:** *Operations given in this subparagraph and the following subparagraph c are to be performed with the breechblock carrier in open position. Closing the breech before these steps are performed may result in improper assembly or injury to components.*

(1) Place a wood pole through breechblock and, with two men lifting, insert end of pole in carrier. Then push breechblock from pole onto carrier pintle. Rotate operating lever to a position which

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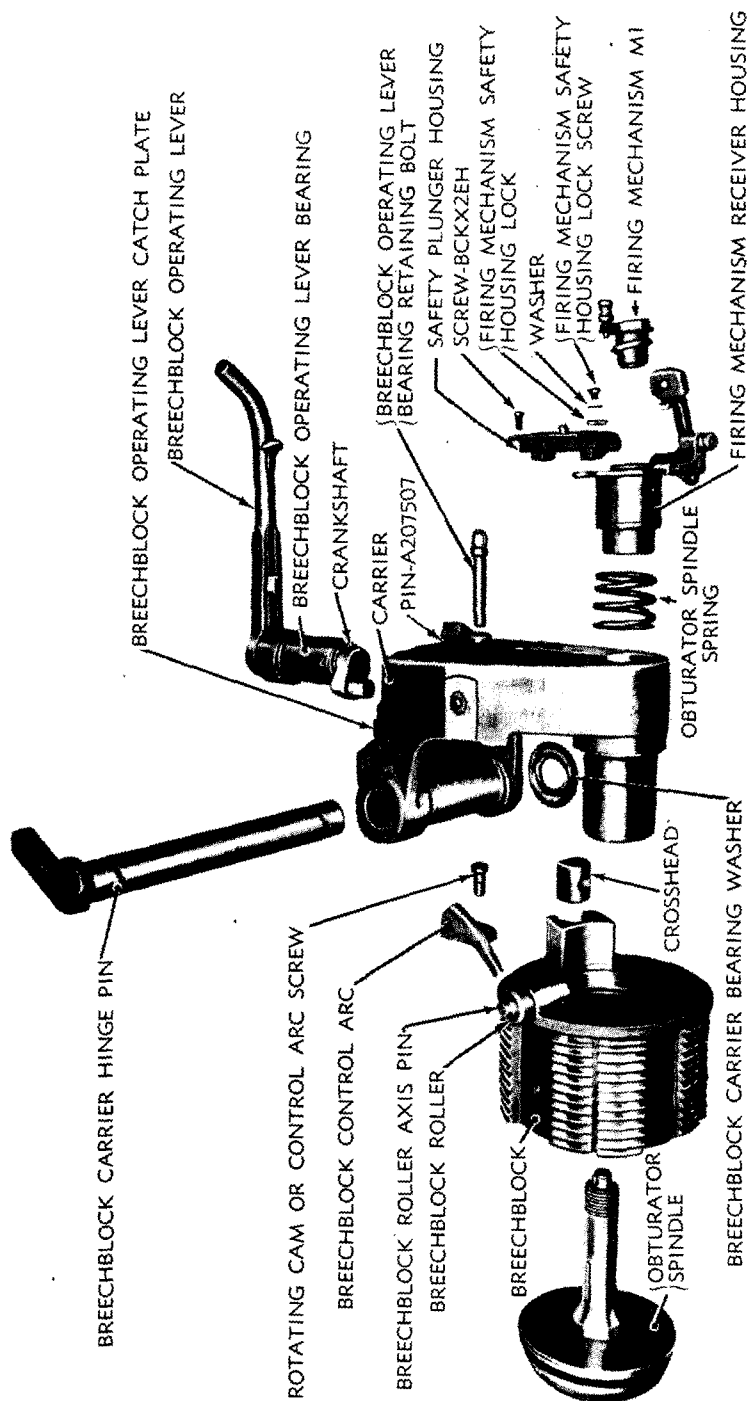


Figure 80 — Breech and Firing Mechanism — Exploded View

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will allow crosshead to enter grooved lug on rear of breechblock. Then slide breechblock all the way into position on the carrier pintle and withdraw wood pole.

(2) Place breechblock control arc in position, and secure with two screws.

c. Install obturator spindle and firing mechanism receiver housing assemblies.

(1) Place a light film of oil all over obturator spindle spring. Slide spring into place in breechblock carrier.

(2) Place in the following order, the front split ring, gas check pad, rear split ring, inner ring, and filling-in disk, on stem of obturator spindle.

(3) Insert threaded end of obturator spindle through spindle opening of breechblock and carrier.

(4) Insert firing mechanism receiver assembly in place in carrier. Press inward on the receiver housing to compress the obturator spindle spring, and screw the receiver assembly on the obturator spindle as far as it will go, making sure gas check pad and split rings are in proper position. Approximately 7 full turns should be made. Insert headspace gage in firing mechanism receiver housing as shown in figure 82. Space between the shoulder of the gage and the housing, as shown in figure 83, denotes proper assembly and proper headspace. If shoulder of gage rests on housing as shown in figure 84, improper assembly and excessive headspace is denoted. When this condition exists, the firing mechanism receiver housing must be screwed 1 or 2 complete turns further onto the obturator spindle. The headspace should again be checked. **CAUTION:** *Excessive headspace between firing mechanism and obturator spindle plug will cause blowback of the primer. Hence, it is essential that firing mechanism receiver housing assembly be screwed onto the obturator spindle as far as it will go. After the firing mechanism safety plunger housing is installed, the receiver housing can be backed off the obturator spindle (subpara. e, below).*

d. Install firing mechanism safety plunger housing assembly.

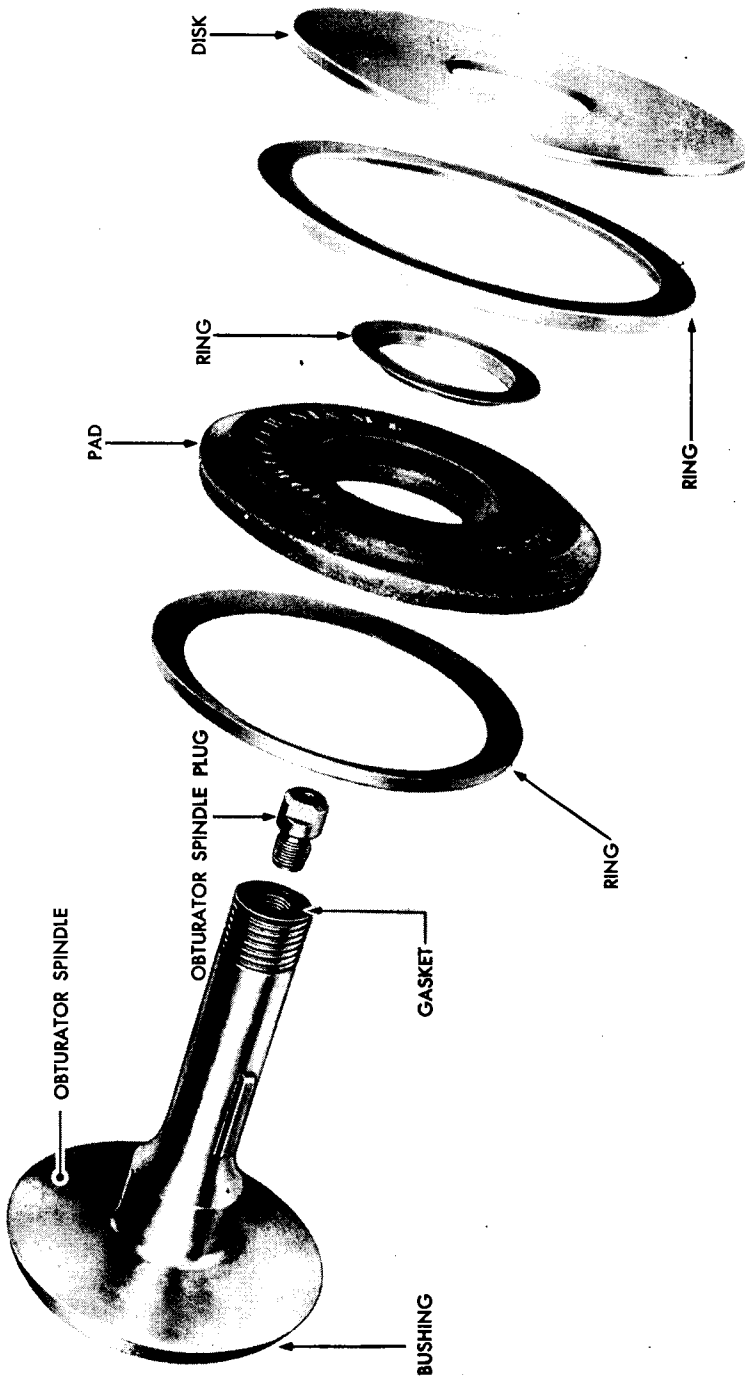
(1) While retaining the lock detent and detent spring in position, fasten the safety housing back to safety plunger housing by screwing in the housing lock screw behind the housing lock screw washer.

(2) Turn housing lock so housing can be placed in its recess in carrier. Slip the left end through flanges of breechblock carrier retainer ring.

(3) Rotate lock 90 degrees to secure housing in position. Detent will now be in the notch in the lock.

(4) Screw flat-head machine screw into place through right end of housing into carrier.

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Figure 81 — Obturator Spindle Assembly Used With the M1 Firing Mechanism

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e. **Headspace adjustment.** Back off the firing mechanism receiver housing assembly slightly to the nearest position where the slot in the housing will align with the firing mechanism safety plunger to allow the safety plunger to enter the slot freely.

f. **Removal.**

(1) Rotate the breechblock carrier until a U-shaped block (or open-end wrench) and small block can be placed over the counterbalance piston rod, between the shoulder on the rod and the counterbalance cylinder rear head. The blocks must be of such size as to hold the piston rod shoulder $2\frac{3}{4}$ inches from the head.

(2) With the U-block and small block in place on the piston rod, swing the breechblock carrier toward the closed position until the larger hole in the piston rod will allow removal of the piston rod over the head of the hinge pin when the keyholed end of the counterbalance cylinder is lifted upward.

(3) Remove the counterbalance bracket collar detent and collar from the upright stud on the counterbalance bracket. Lift the counterbalance assembly from its supports.

g. **Disassembly of the counterbalance assembly.** The counterbalance assembly contains a strong spring which requires special tools and equipment for compressing. Whenever the counterbalance assembly requires disassembly, notify ordnance maintenance personnel.

h. **Installation.**

(1) Rotate the breechblock carrier until the large hole in the end of the counterbalance piston rod will slip over the head of the hinge pin at the same time that the drilled lug on the counterbalance cylinder head slips over the stud on the counterbalance bracket.

(2) With the counterbalance in place, put the counterbalance bracket collar on the bracket stud and secure it with the counterbalance bracket collar detent. See that the detent is slightly bent before insertion.

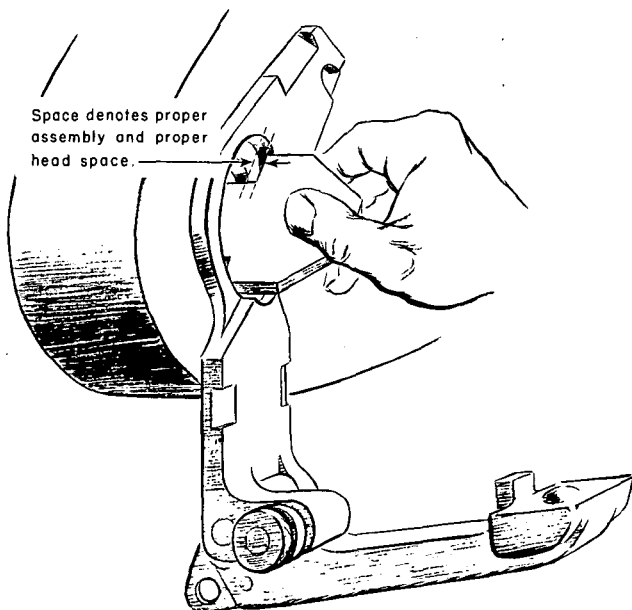
(3) Rotate the breechblock carrier toward open position until the U-shaped block and small block which holds the counterbalance piston rod spring in compression can be removed.

62. MAINTENANCE OF BREECH MECHANISM.

a. **Breech mechanism.** Note smoothness of operation of the breech mechanism in opening and closing. If the mechanism binds or does not operate smoothly, disassemble, clean, examine the parts for wear or breakage, and replace unserviceable parts. Lubricate the mechanism and reassemble. If it is still difficult to operate, notify ordnance maintenance personnel.

b. **Breechblock and breech recess.** Examine the breechblock and breech recess for burs, indentations on the threads, rust, pitting,

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RA PD 50499

Figure 82 — Method of Using Gage To Check Assembly for Proper Headspace

and other evidence of erosion. If not possible to smooth or clean with crocus cloth, notify ordnance maintenance personnel. Do not use any other abrasive.

c. **Breechblock carrier assembly.** Examine the breechblock carrier assembly, the machined surface on which the breechblock rotates, and hinge pin for a roughened or scored condition. Remove roughness or scores with crocus cloth.

d. **Obturator spindle.** Examine obturator spindle for burs. If possible, smooth the spindle using crocus cloth; if not possible, notify ordnance maintenance personnel.

e. **Split rings.** Examine the split rings for burs or cracks. Replace defective rings.

f. **Gas check pad.** Examine gas check pad for bruises or torn covering. Replace defective pad.

g. **Daily,** when the gun is not being fired, the breech mechanism (except the gas check pad) must be cleaned thoroughly, dried, and coated with a thin film of oil. Application to moving parts will be by oilcan if oilholes are provided, otherwise, use a clean wiping cloth. Disassembly will be undertaken if necessary to insure complete lubrication of all moving parts.

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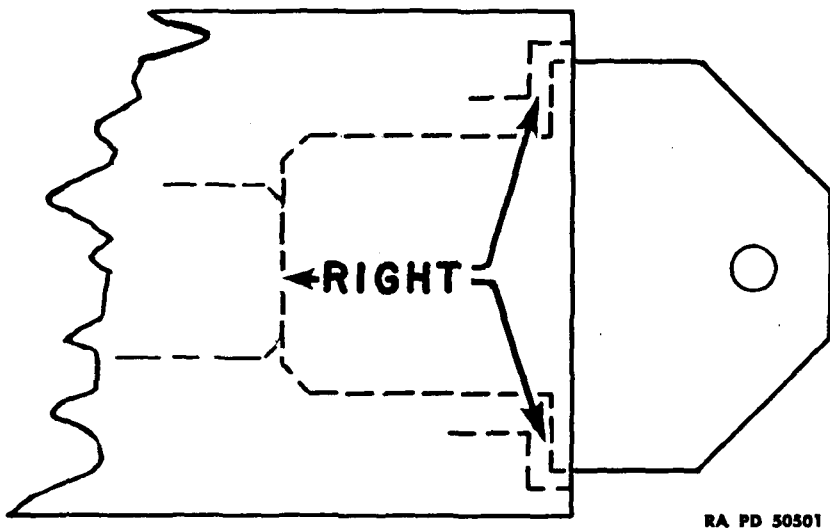


Figure 83 — Correct Use of Headspace Gage

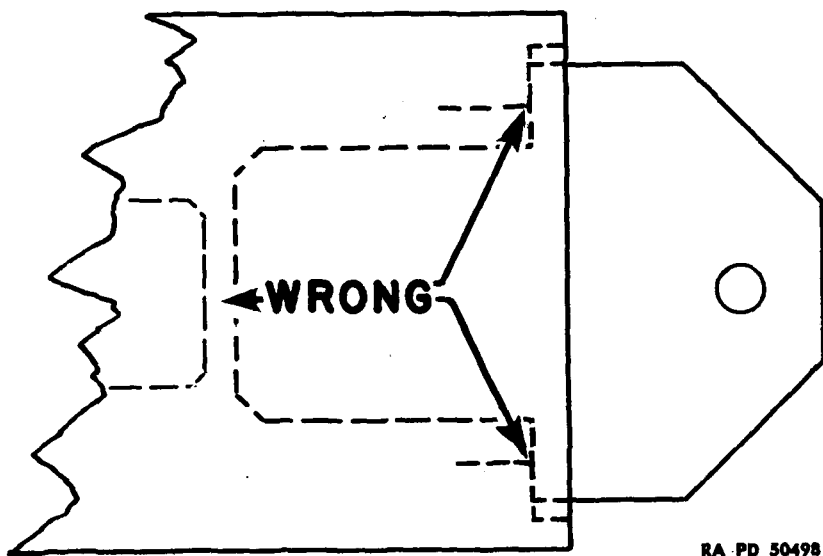
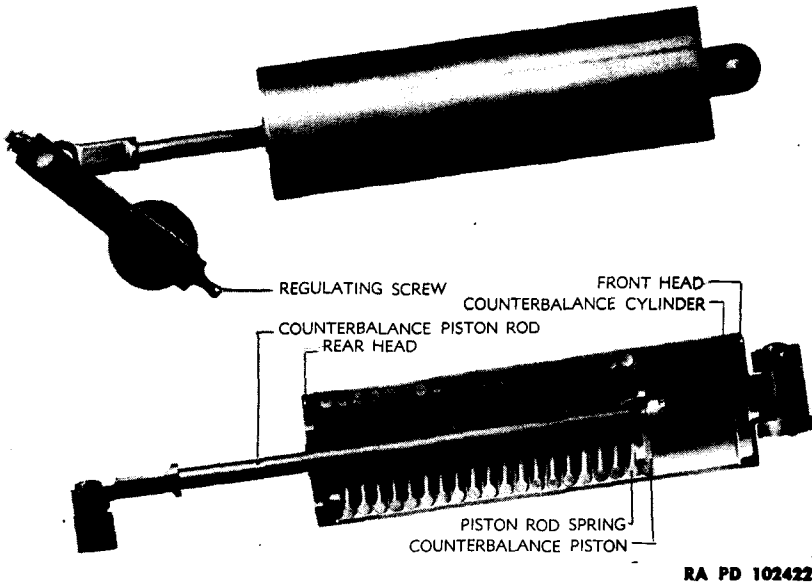


Figure 84 — Incorrect Use of Headspace Gage

h. The entire breech mechanism including the firing mechanism M1, obturator spindle, primer seat, primer vent, filling-in disks, split rings, etc., should be disassembled and (except the gas check pad) cleaned immediately after firing, in the same solution used to swab the bore. All traces of powder fouling and primer residue should be

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RA PD 102422

Figure 85 — Counterbalance Mechanism

carefully removed. After rinsing in clean water, dry thoroughly, and coat with oil. Application to moving parts will be made by oilcan if oilholes are present, otherwise, use a clean wiping cloth. Cleaning will be repeated daily until all traces of primer residue have been removed. Daily and after firing, firing lock M17 will be cleaned with dry-cleaning solvent, wiped dry, and oiled. Do not clean this mechanism with soda-ash or soap solutions.

i. Gas check pads.

(1) Extreme care should be exercised in cleaning the gas check pad. After removal from the obturator spindle, the gas check pad will be wiped clean with a dry cloth. A film of oil will not be applied. Oil causes rapid deterioration, therefore, gas check pads will always be replaced dry at assembly. Never clean the gas check pad with dry-cleaning solvent or any other type of cleaning solution. **CAUTION:** *When cleaning the breech assemblies, precaution should be taken that no bore swabbing solution or dry-cleaning solvent ever comes in contact with the gas check pad.*

(2) The old type gas check pad should be examined for bruises or torn covering. Replace defective pad. Damage to gas check seat cannot be repaired by stoning or polishing, therefore, extreme care must be taken to inspect the pad. The Neoprene rubber gas check pad is not affected by normal use of oil, solvents, rifle bore cleaner, or water. It is not seriously affected if dropped to the ground or by

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moderately rough handling. Chafing from the openings in the split rings does not seriously affect the proper functioning and serviceability of the Neoprene pads. Periodic reports on operation, maintenance, serviceability, and malfunctioning of the Neoprene gas check pads should be submitted through technical channel to Officer, Chief of Ordnance, Attn: SPOFM.

j. **Leveling plates.** The leveling plates should be protected. Tools or other articles will not be placed upon them. In case of damage, repair must be made by ordnance maintenance personnel.

Section XVIII**FIRING MECHANISM M1 AND PERCUSSION MECHANISM****63. GENERAL.****a. Firing mechanism (figs. 86 and 87).**

(1) The exterior of the firing mechanism block has a large single thread for screwing into the firing mechanism receiver housing.

(2) The primer holder (fig. 87) has a left hand thread to prevent it from becoming loose when the firing mechanism is inserted into its receiver housing. The firing pin is guided by the firing pin housing at the rear end and by the part called the guide, at the front end. The pin is held rearward by the firing spring. Set screws secure the primer holder and the firing pin housing.

(3) The front of the primer holder has a U-shaped slot which engages the rim of the primer. The primer is retained in position by the pressure of the firing pin spring bearing against the firing pin guide.

b. Percussion mechanism.

(1) The percussion mechanism consists of the hammer and hinge pin, and the hammer locking pin. These are mounted on the lower arm of the receiver housing. When a lanyard is attached to the hammer and pulled, the hammer swings in an arc, and strikes the firing pin of the firing mechanism, firing the piece (fig. 86).

(2) When the hammer locking pin is released, it protrudes in the path of the hammer and prevents the hammer from being raised. When the knob is drawn to the left and turned, the locking pin is held from the path of the hammer, and the hammer is permitted to swing in its arc. When the hammer is raised, the knob can be turned until the locking pin enters a recess in the hammer, holding the hammer in an inoperative, upright position.

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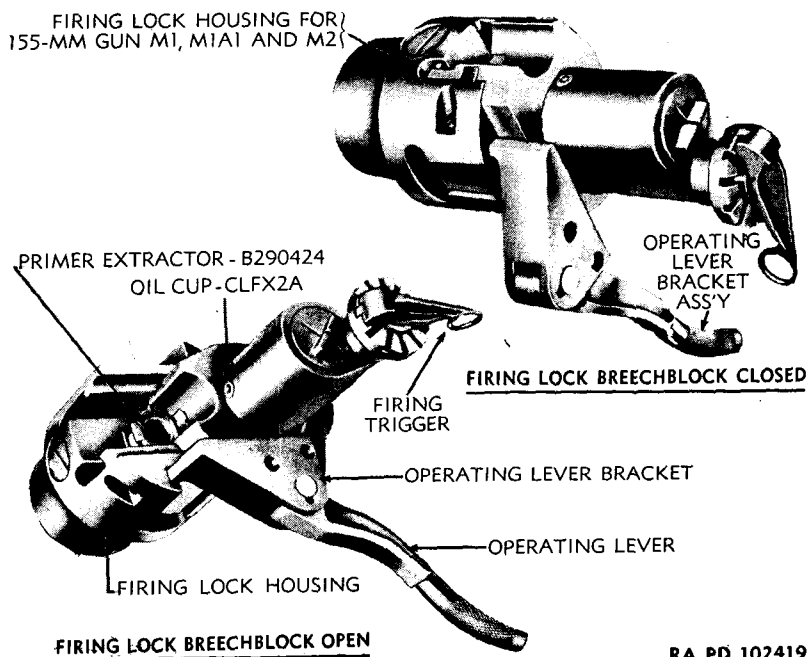
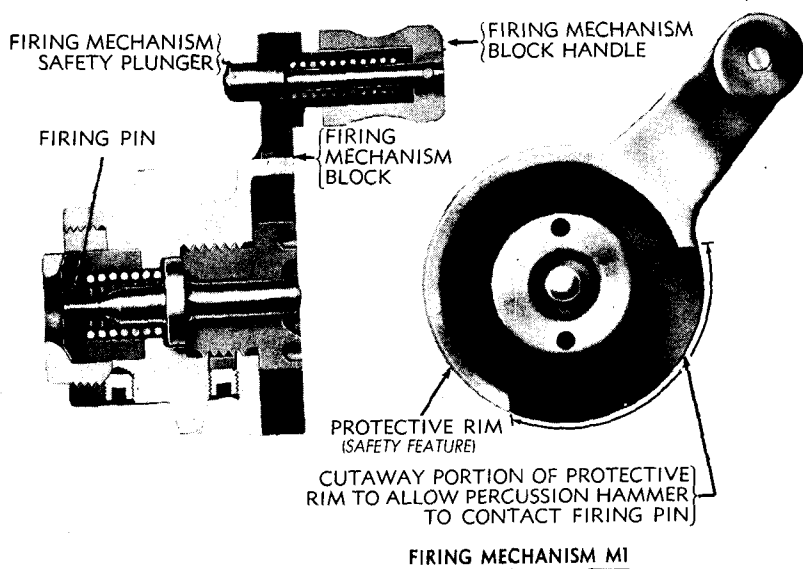


Figure 86 — Firing Mechanism M1 and Firing Lock M17

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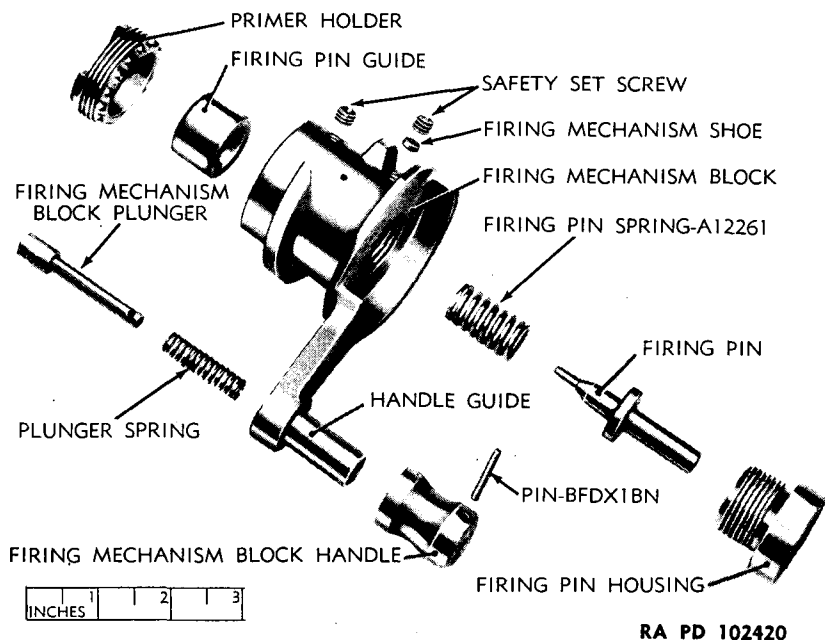


Figure 87 — Firing Mechanism M1 — Exploded View

64. DISASSEMBLY OF FIRING MECHANISM M1 (fig. 87). Remove the safety set screw from the primer holder and unscrew the primer holder. Remove the firing pin guide and the (firing pin) compression spring. Remove the safety set screw and shoe, unscrew the firing pin housing with the wrench provided, and remove the firing pin.

65. ASSEMBLY OF FIRING MECHANISM M1. Place the firing pin guide in its seat in the block and screw the primer holder firmly into its seat, which will hold the guide in position. Aline the nearest serration in the primer holder in the center of the set screw hole. Lock the primer holder with the safety set screw. Place the firing pin spring in the firing pin guide, and the firing pin in the spring. Screw the firing pin housing into the rear end of the firing mechanism block, and assemble the shoe and safety set screw. When the set screws are seated, they must be flush or below the outside of the firing mechanism blocks.

66. DISASSEMBLY OF PERCUSSION MECHANISM. Disassemble the percussion mechanism, starting with the positioning pin located in the knob (fig. 80), then remove the pin in the knob to release the spring and locking pin. Remove pin in forked end of receiver to release hinge pin, then remove percussion hammer.

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67. ASSEMBLY OF PERCUSSION MECHANISM. Referring to figure 80, the assembly of the percussion mechanism can be accomplished by a reverse of the disassembly operations.

Section XIX

FIRING LOCK M17

68. GENERAL. The firing lock M17 (figs. 86, 88, and 89) is known as the continuous-pull, self-cocking type; that is, no cocking of the firing pin is required other than a pull on the trigger. This arrangement permits repeating the blow from the firing pin in case of a misfire as often as desired without opening the mechanism or recocking the firing pin. The firing lock, once installed, remains on the weapon and is not removed between successive rounds. This lock is provided with a drop block and the primer is inserted in a manner similar to putting a cartridge in a rifle.

69. REMOVAL OF THE FIRING LOCK. Remove the safety plunger and safety plunger sleeve and unscrew the firing lock and housing from the obturator spindle. *NOTE: This operation should not be attempted unless the breechblock of the cannon is open.* Swing the firing lock operating handle to the right until it disengages the firing lock body. Slide the breechblock clear of the firing lock housing (fig. 90).

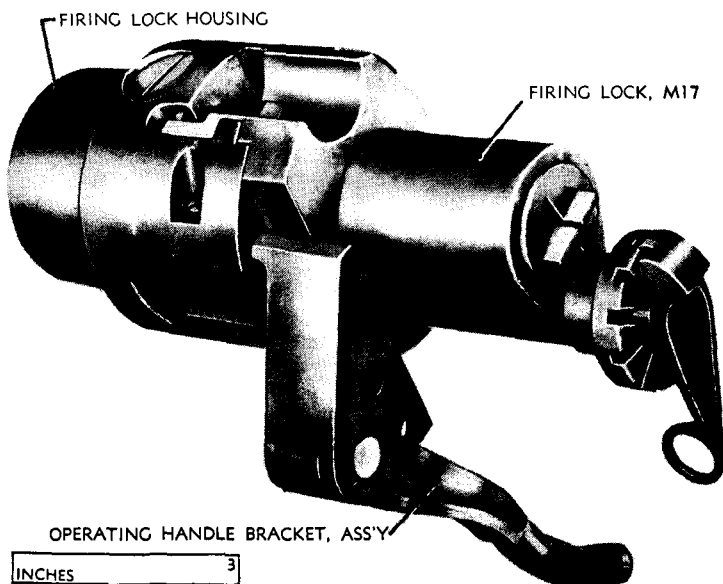
70. DISASSEMBLY OF THE FIRING LOCK M17.

a. Remove face plate retaining pin and remove face plate. Lift out firing pin and firing spring (fig. 91).

b. Screw the firing spring locking cap in until it unlocks from the selector. Unscrew the selector four turns and trip the trigger to relieve firing spring pressure. Unscrew trigger assembly and remove.

c. Unscrew firing spring locking cap and remove firing spring. Remove firing hammer and firing spring stop (fig. 91).

d. Compress pull rod spring until the firing trigger pivot pin can be driven out. Remove firing trigger. Compress the pull rod spring further until the keyed end of the pull rod clears the pull rod washer. Rotate the pull rod 90 degrees to align keyed end with the open end of the washer. Remove pull rod and spring. Remove pull rod bushing from the pull rod. Remove tripper pin and tripper. Remove pull rod washer and rotor from the firing trigger selector (fig. 91).

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Figure 88 — Firing Lock M17 — Closed Position

71. REMOVAL AND DISASSEMBLY OF OPERATING HANDLE BRACKET ASSEMBLY. Remove the operating handle bracket pin, and slide the operating handle bracket out of the firing lock bracket. Rotate the operating handle until the keyway in the bracket lines up with the keyway in the lever. Remove the operating handle pivot pin and remove the handle (fig. 89).

72. ASSEMBLY AND INSTALLATION OF OPERATING HANDLE BRACKET ASSEMBLY. Place the operating handle in the operating handle bracket and align the keyways. Insert the operating handle pivot pin and rotate the handle to lock the pin. Replace the operating handle bracket assembly in the firing lock housing and lock in place with the operating handle bracket pin.

73. ASSEMBLY OF THE FIRING LOCK M17.

a. Assemble the firing hammer tripper to the pull rod and lock in place with the tripper pin. Assemble the pull rod bushing with inner shoulder of the bushing to the rear. Place the pull rod spring over the pull rod. Replace the firing trigger rotor and the pull rod washer in the firing trigger selector. Insert the pull rod in the selector and align the keyed end of the pull rod with the open slots in the pull rod washer. Compress the pull rod spring and push the

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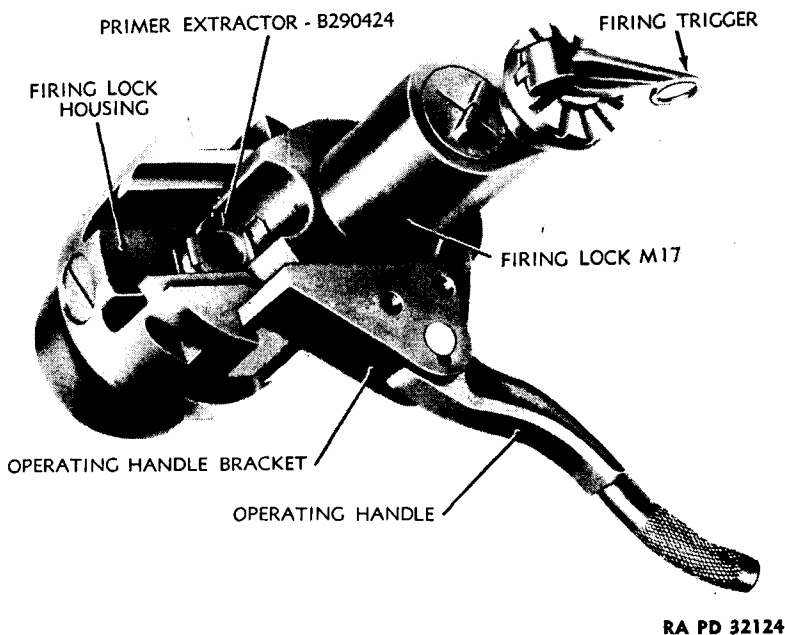


Figure 89 — Firing Lock M17 — Open Position

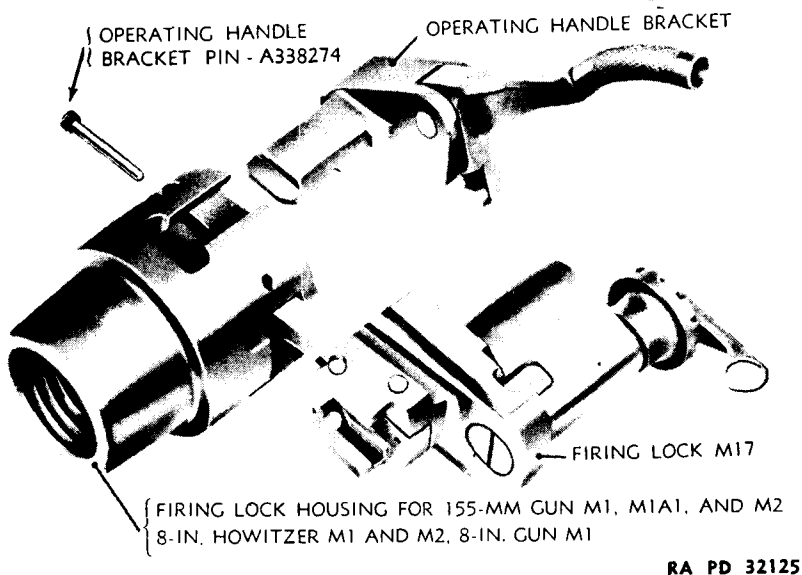


Figure 90 — Firing Lock and Housing

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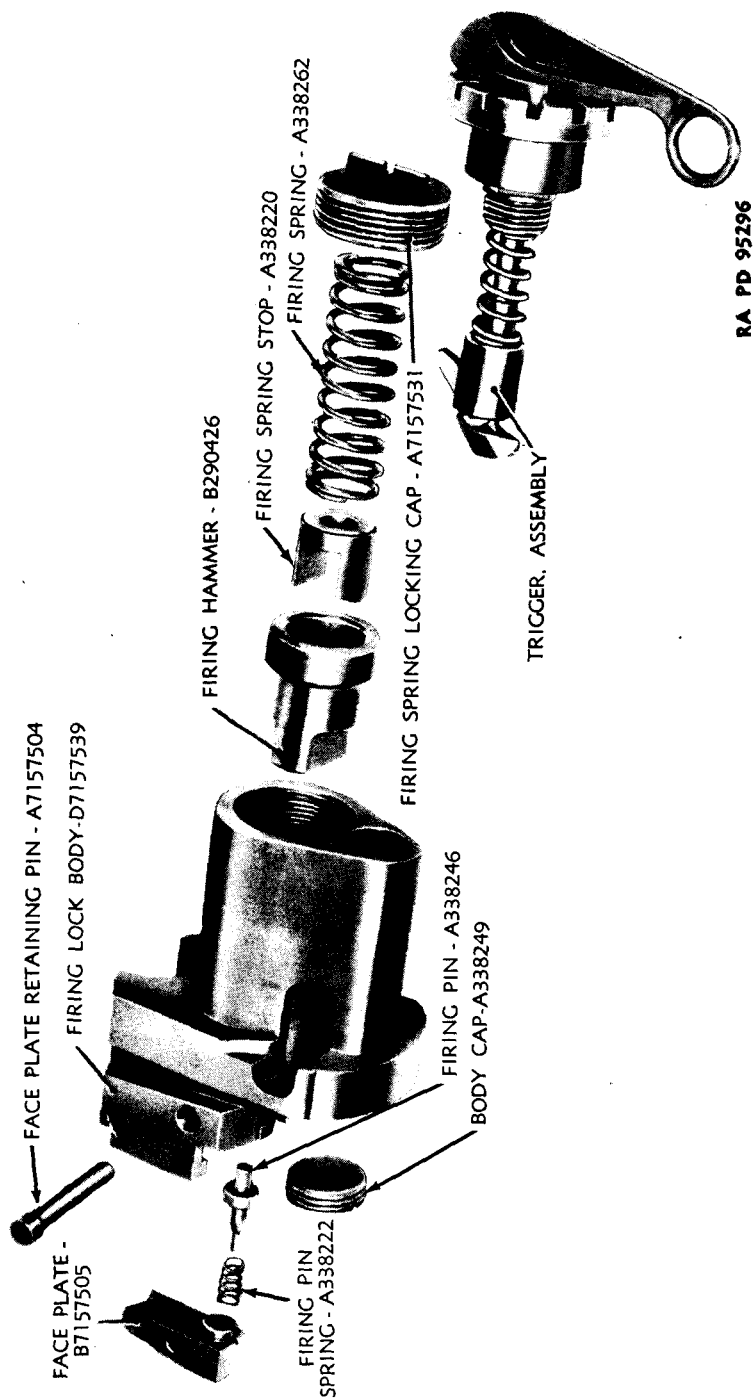


Figure 91 — Trigger Assembly and Firing Hammer and Spring — Exploded View

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keyed end of the pull rod through the washer and rotate the pull rod at 90 degrees to align the keyed end of the pull rod with the closed slots in the washer. Further compress the spring and place the firing trigger in the rotor. Align the holes and replace the firing trigger pivot pin. Release spring tension.

b. Place the firing spring stop in the firing hammer. Replace the hammer and stop in the firing lock body. Install the firing spring and the firing spring locking cap and screw in cap until snug (fig. 91).

c. Insert assembled trigger assembly into the body. Screw in selector as far as possible, then back off until locking groove on face of selector is aligned with the tip of the firing spring locking cap. Unscrew the locking cap until it stops against the face of the selector.

d. Replace the firing pin in the body and place the firing pin retracting spring in place. Assemble the face plate over the firing pin and spring and lock in place with the face plate retaining pin (fig. 91).

74. INSTALLATION OF THE FIRING LOCK M17.

a. Assemble the obturator spindle and the obturating parts to the carrier. Assemble the obturator spindle spring. Screw the firing lock M17 onto the obturator spindle until it stops against the rear face of the shoulder on the obturator spindle plug.

b. Unscrew the firing lock until the elongated hole in the left side of the firing lock housing is aligned with the safety plunger hole in the carrier. Install the safety plunger mechanism.

75. CARE AND PRESERVATION.

a. The firing lock (fig. 86) should be kept clean and the parts lightly lubricated. When not in use, remove from the gun.

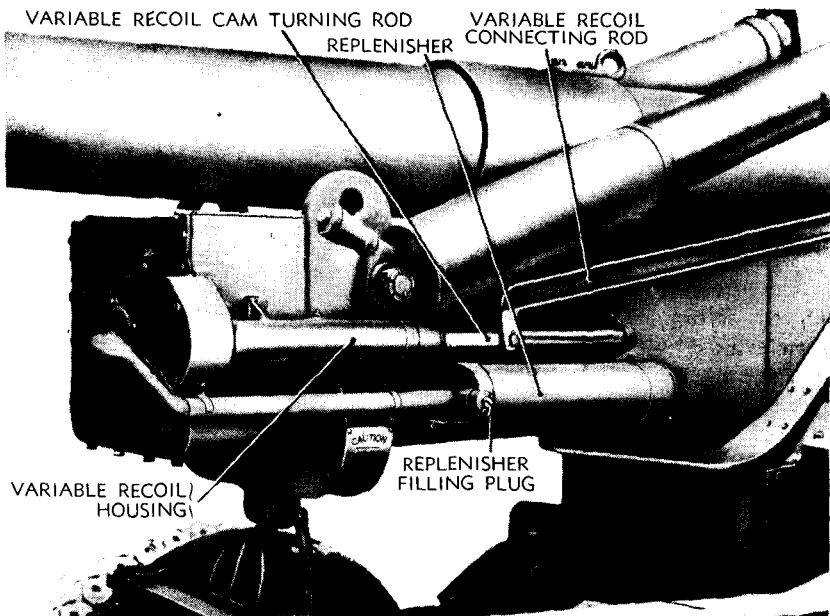
b. If the firing lock does not work smoothly, or if it requires a greater effort than usual to operate, it should be disassembled and examined. Scoring or bruises on the body or firing lock housing should be reported to ordnance maintenance personnel.

Section XX

RECOIL MECHANISM M3 AND CRADLE

76. RECOIL MECHANISM M3.

a. **General.** The 155-mm gun recoil mechanism M3 is of the hydropneumatic (variable) recoil type. It is composed essentially of the recoil cylinder, counterrecoil cylinder, and recuperator cylinder (all of which are assembled in the cradle), and the replenisher cylinder (fig. 97). The function of the recoil portion of the recoil

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RA PD 102411

Figure 92 — Replenisher and Variable Recoil Mechanisms

mechanism is to absorb and dissipate part of the recoil energy by compressing the nitrogen gas in the counterrecoil system, limiting length of recoil, and bringing recoiling parts to rest. The function of the counterrecoil and recuperator portions of the recoil mechanism is to store the remainder of the recoil energy. Upon completion of recoil, this stored energy is utilized to return the gun to the in-battery or firing position.

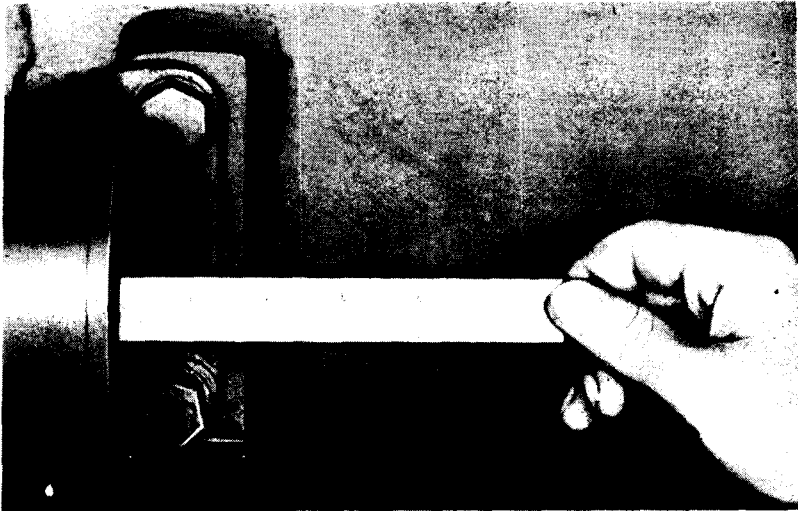
b. Recoil.

(1) During recoil, oil in the recoil cylinder is throttled through openings past the recoil piston, so that recoil energy is absorbed and the gun motion is slowed to a stop. The throttling rod, housed in the recoil piston rod, remains stationary when the gun is fired.

(2) When elevating or depressing the gun, rotation of the control rod controls the size of orifice through which the oil is forced past the piston and this provides a variable recoil. Raising the gun changes the grooves in the recoil cylinder through which the oil is throttled and shortens the length of recoil.

(3) The rear end of the throttling rod acts as a buffer at the end of the counterrecoil motion, throttling a small amount of the recoil oil through throttling grooves and into the recoil cylinder, and slowing down the counterrecoil action so that the gun is eased into battery position.

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RA PD 86544

Figure 93 — Measuring Position of Replenisher Piston

(4) A replenisher is connected to the front end of the recoil cylinder (fig. 92). It serves as a reservoir for excess oil when increased atmospheric temperature or heat develops during firing which expands the oil, and keeps the recoil cylinder filled when the oil contracts because of falling temperature. A filling and drain plug is provided on the muzzle end of the replenisher.

c. **Counterrecoil.** The counterrecoil parts of the recoil mechanism are contained in the recuperator and counterrecoil cylinders. These cylinders are connected near the rear ends. A regulator valve, which is open during recoil and closed during counterrecoil, is mounted near this connection in the breech end of the recuperator cylinder. During recoil, the motion of the counterrecoil piston forces oil from the recoil cylinder to open the regulator valve for the easy passage of oil into the oil in the recuperator cylinder, and forces the floating piston in the recuperator cylinder forward to compress further the nitrogen gas in the forward end of the recuperator cylinder. This absorbs some of the energy of recoil and stores it for the counterrecoil action. When the recoil action ceases, the counterrecoil action starts. The oil in the rear of the recuperator is throttled through the regulator valve in returning to the counterrecoil cylinder. This oil forces the counterrecoil piston and the gun back into battery position.

d. **Oil index.** The position of the floating piston in the recuperator cylinder and the amount of oil in reserve is indicated (par. 80 b)

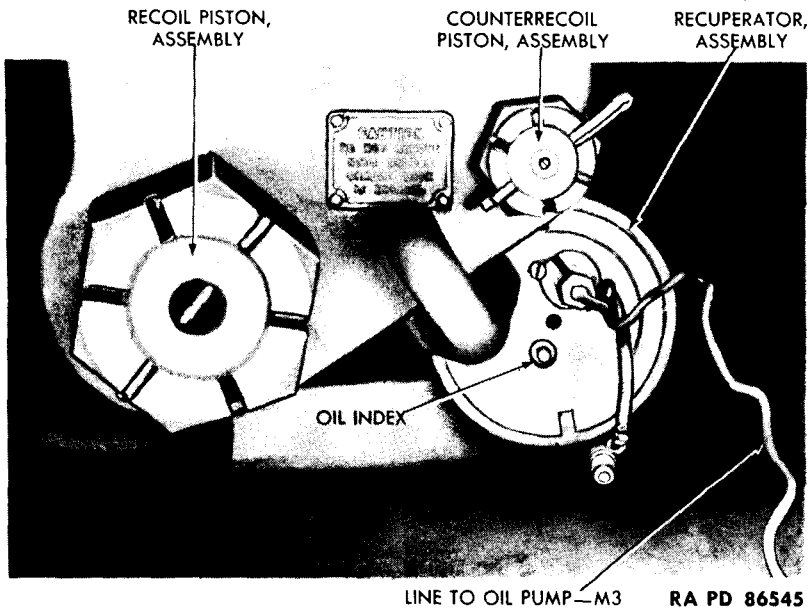
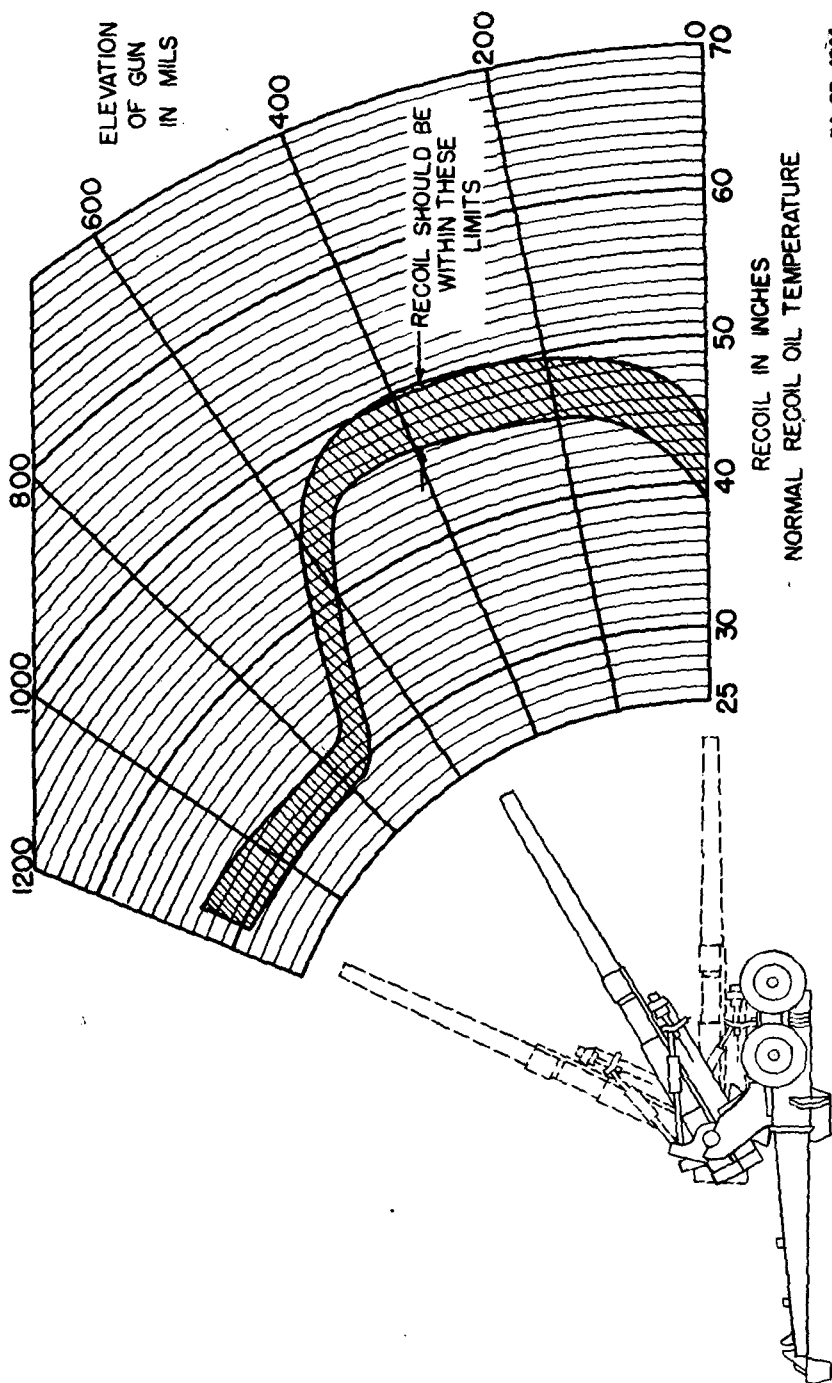
Part Three — Maintenance Instructions

Figure 94 — Pumping Oil Reserve Into Recuperator

by a small rod which extends through the cylinder head. If there is a full reservoir, the oil index will project 5 millimeters or approximately 0.20 inch beyond the face of the oil index housing. If there is insufficient reserve, the oil index will project less than 5 millimeters and may completely disappear. When the oil index projects less than 5 millimeters, it is necessary to drain completely and refill the oil reservoir as described in paragraph 80.

77. CRADLE. The cradle is mounted on the trunnion bearings of the top carriage. It houses the recoil, counterrecoil, and recuperator cylinders, and has the replenisher cylinder attached. The cradle trunnions form the fulcrum for the movement of the gun in elevation. One end of each of the two equilibrators is secured to the cradle near its front end. The other end of the equilibrators is attached to the trunnion cap on the top carriage. A cradle lock connection at the front end secures the cradle lock mount on the bogie to the cradle and is used to hold the cradle in travel position. The elevating arc, which is engaged by the pinion of the elevating mechanism, is secured in alinement on the bottom of the cradle by a projection which fits a mating groove in the cradle. The replenisher and the variable recoil mechanism are assembled to the left side and front end of the cradle. A gun retracting hoist is used for retracting the gun.

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EA PD 4266

Figure 95 — Limits of Length of Recoil — Normal Charge

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78. RECOIL OIL.

a. General. Care must be taken not to use other than the recoil oil prescribed by the Lubrication Order.

(1) Water must not be introduced into recoil mechanism.

(2) Exposure of recoil oil in an open can may result in accumulation of moisture. Condensation in a container partly filled with oil, or pouring from one container to another which has moisture on its inner walls, results in moisture being carried along with the oil into the recoil mechanism.

(3) It is advisable that recoil oil be tested for water. Use a clean glass bottle filled with recoil oil. The oil should be put in a warm place and allowed to settle. If water is present, the water being heavier than the oil will sink to the bottom. With the bottle slightly tilted, drops or bubbles will form in the lower portion. Invert the bottle and hold it to the light. Drops or bubbles of water, if present, may be seen slowly sinking in the oil. If the oil has a cloudy appearance, the cloudiness may be ascribed to particles of water.

(4) If this test should show the presence of water, the oil on hand should be turned in.

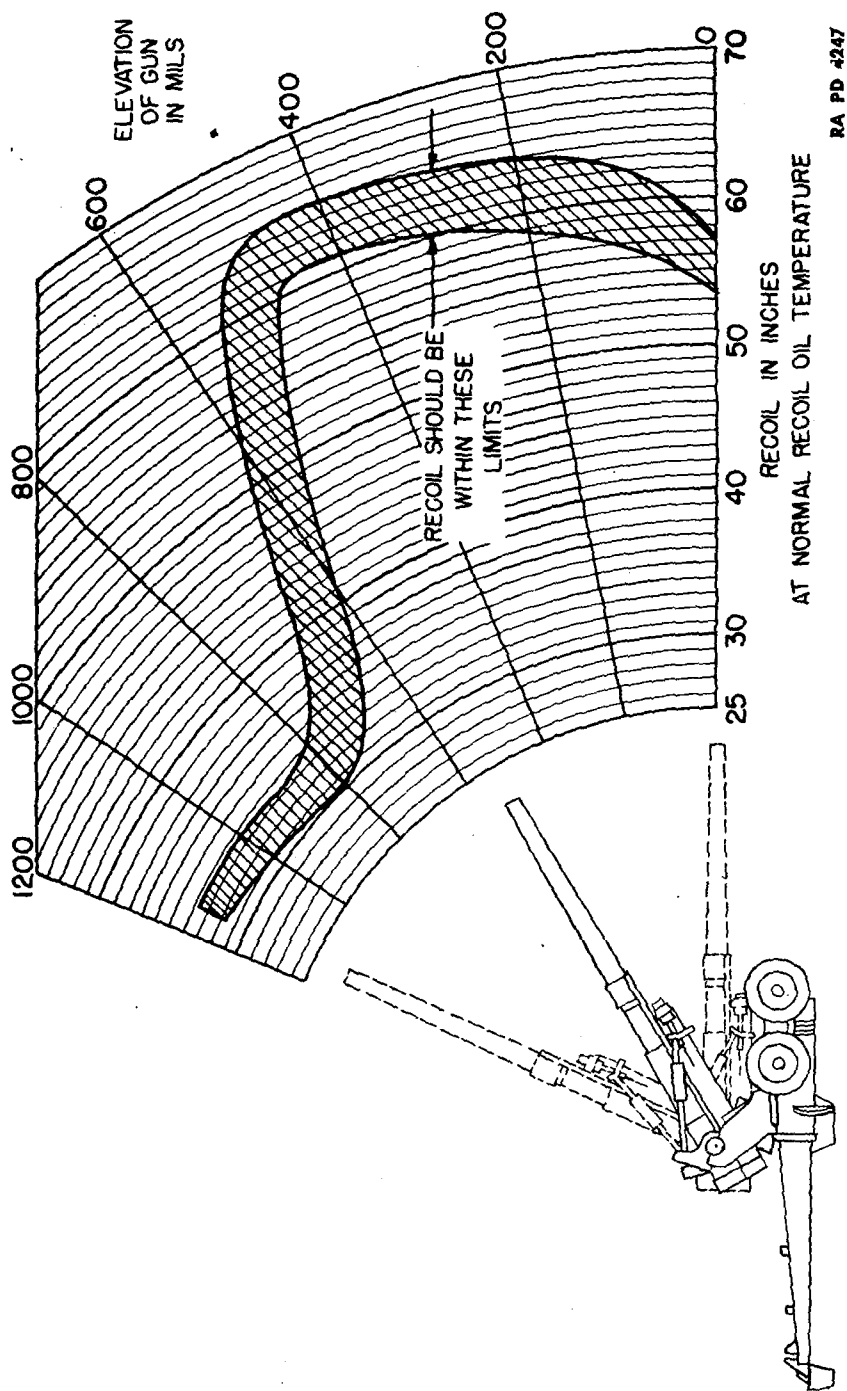
b. Care of recoil oil. The transfer of recoil oil to a container not marked with the name of the oil may result in the wrong oil getting into the recoil mechanisms or in the use of recoil oil for lubricating purposes. Recoil oil must not be put into a container not marked with the name of the oil. The following should also be observed: Recoil oils should not be left in open containers, nor subjected to excessive heat. The greatest care must be taken with the recoil oils to exclude moisture and dirt. Except in an emergency, dirty recoil oil should be replaced with new oil. Strain used recoil oil through clean cloth before reinserting in recoil mechanism in the event an emergency arises requiring such reuse. Do not mix recoil oils with any other type of oil.

79. FILLING RECOIL CYLINDER WITH OIL.

a. Purging means removing all air from the line when forcing in the oil. This is accomplished by having one connection in the line slightly loose, and allowing the air to escape, after which the connection is tightened.

b. The recoil cylinder is filled through the replenisher with the oil pump M3. The position of the replenisher piston governs the filling of the recoil cylinder (fig. 93). The normal position of the replenisher piston is $5\frac{3}{4}$ inches (150 millimeters) from the rear face of the replenisher cylinder. This position indicates a full cylinder and sufficient reserve in the replenisher. Check the position of the replenisher piston and, when the replenisher piston is at a point 4 inches

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RA PD 4247

Figure 96 — Limits of Length of Recoil — Supercharge

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(100 millimeters) or less from the rear face of the replenisher, remove oil from the replenisher before firing is continued. The removal of oil is accomplished by means of the filling and drain valve release (oil extractor). When the replenisher piston has moved in to a point $7\frac{7}{8}$ inches (200 millimeters) or more from the rear face of the replenisher, add oil.

c. Before filling the replenisher with oil, test the operation of the replenisher piston, by inserting a scale through the opening of the replenisher piston guide and against the replenisher piston, after removing plug. Then release oil from the replenisher by means of the filling and drain valve release (oil extractor) screwed into the replenisher filling and drain hole on the side of the replenisher. If movement of the replenisher piston takes place, proceed with the filling of the recoil cylinder as follows: Unscrew the filling and drain valve release from the replenisher filling and drain hole, screw union of the pump filling tube into the filling and drain hole loosely, and pump a little oil through until all air is excluded. The union should be set up without the use of a wrench, except for the final tightening, and should be just tight enough to prevent oil from escaping. Extreme care must be taken to prevent any damage to the threads of the filling and drain hole, as any damage may put the cradle out of action. Work the pump until the rear end of the replenisher piston is $5\frac{3}{4}$ inches (150 millimeters) from the rear face of the replenisher. Remove the filling pipe union and replace the filling and drain plug.

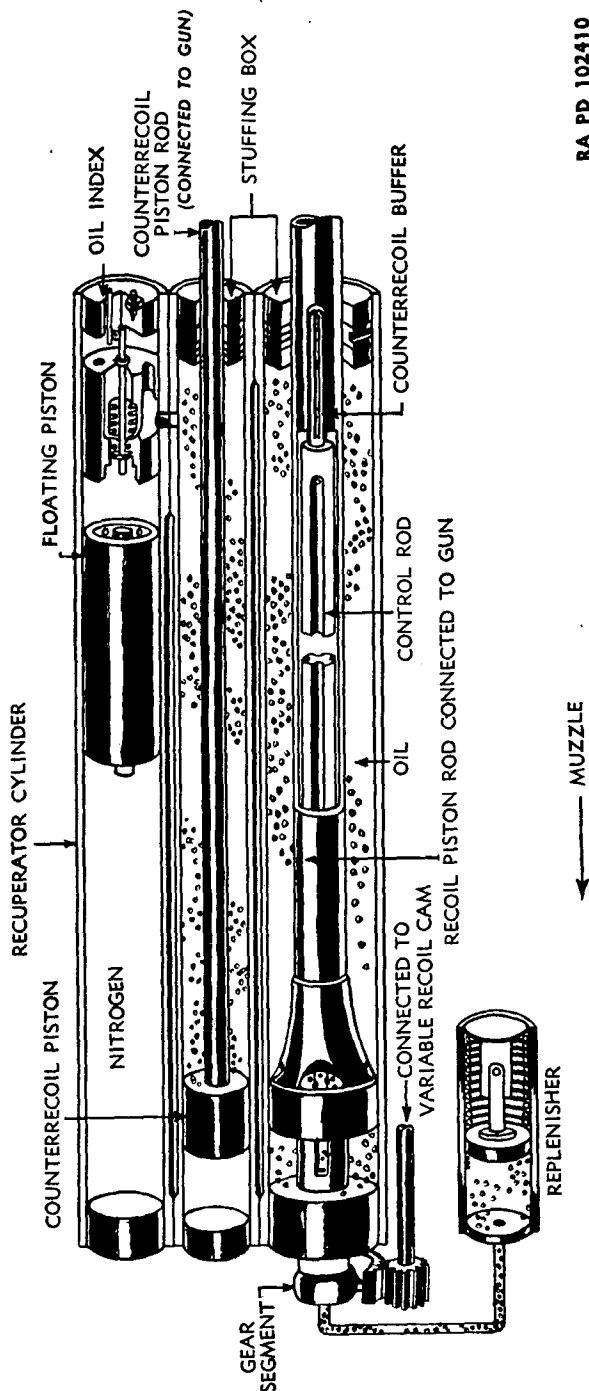
d. Measurement of the replenisher piston should conform to the following: *Before firing*, for anticipated slow fire, from $5\frac{3}{4}$ inches to $7\frac{7}{8}$ inches; for anticipated rapid fire and extreme high temperatures, $7\frac{7}{8}$ inches. *During firing* $7\frac{7}{8}$ inches to "0." Firing should not continue before "0." "0" measurement is obtained when the rear face of the replenisher piston is flush with the rear face of the replenisher. When replenisher piston approaches "0" measurement, drain oil from replenisher. **CAUTION:** *Be sure to fill replenisher at the end of the day's firing to take care of the contraction of oil which will take place when the system cools off. Never allow replenisher to go beyond the "0" measurement.*

80. FILLING RECUPERATOR CYLINDER WITH OIL (fig. 94).

a. The following instructions, as to the number of strokes, apply only to the oil pump M3.

b. The position of the oil index, which is below the filling and drain plug, should not be used as an absolute guide for determining whether or not the counterrecoil system contains the proper amount of oil. The normal position of the oil index in the counterrecoil system is 5 millimeters (0.20 inch) out from the rear face of the recuperator cylinder. This position is not a definite indication of the

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RA PD 102410

Figure 97 — Variable Recoil Mechanism With Replenisher — Schematic View

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amount of oil in the system. If the index extends out less than 5 millimeters, it is a definite indication that there is not sufficient oil. On the other hand, it may extend out 5 millimeters, and there may not be sufficient reserve in the system. The only way to know that the system is full is by filling it.

c. When the gun does not return to battery, or the position of the oil index indicates that there is too small a quantity of oil in the recuperator, it will be necessary to drain off the reserve oil before refilling. This is accomplished by removing the plug from the filling and drain hole located on the breech end of the recuperator. Screw in the filling and drain valve release (oil extractor), and allow oil to drain until the flow ceases. Remove the filling and drain valve release (oil extractor). It will be noted that the oil index has receded before all of the reserve oil has been released. If the oil index has not moved, tap it gently with a small piece of wood, as it may be stuck. Purge the oil pump, clean the union of the pump tubing or hose, and screw the union loosely into the filling and drain hole. Work the pump a few times until oil is forced out through the connection, thereby excluding all air. The pump must be kept filled, during operation, to a level sufficient to avoid it running dry. If air should get in the tubing, it will be necessary to purge the line again. Tighten the union just sufficiently to prevent further escape of oil through the connection as the pump is operated. To establish a correct reserve, pump in sufficient oil to bring the oil index to its extended position. Count the number of strokes. Then add twice this amount of oil. (For example, if it requires 150 strokes to bring out the oil index, then add *another* 300 strokes. One stroke is considered one complete cycle of the pump handle.) This quantity of oil is considered the correct reserve.

Section XXI

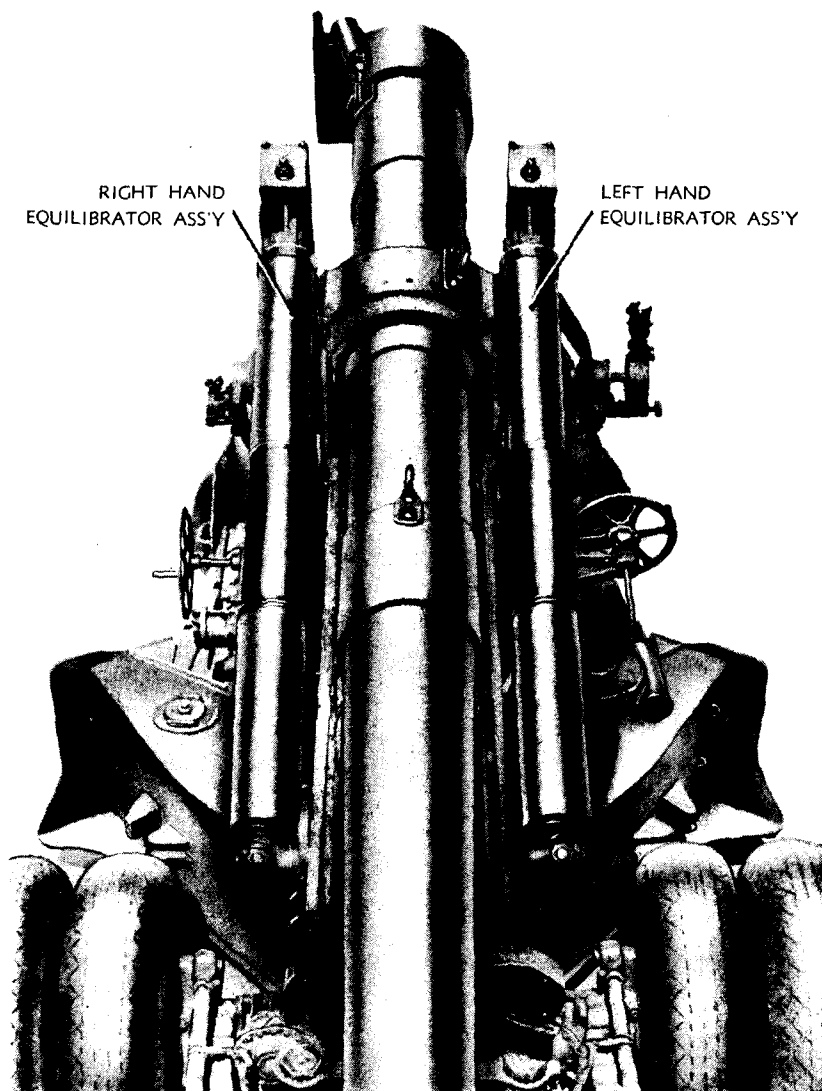
EQUILIBRATORS

81. GENERAL.

a. Two equilibrators of the pneumatic type (fig. 98) are provided to balance the weight of the gun muzzle and reduce the manual effort required to elevate the gun through the lower elevations. They consist primarily of cylindrical cases and plungers (fig. 99). They are filled with nitrogen gas under pressure and are equipped with appropriate grease seals to retain the gas. **NOTE:** *The equilibrators are not to be disassembled except by ordnance personnel.*

b. Temperature adjustment scale (fig. 26). Temperature adjustment scales are provided on both sides of the gun to provide for an adjustment of the tension of the equilibrators for various

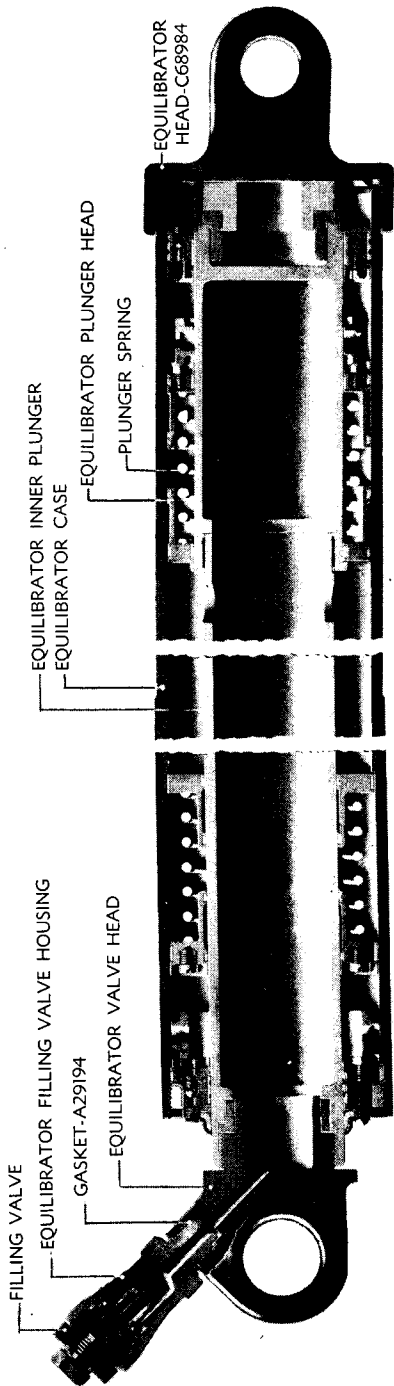
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RA PD 102383

Figure 98 — Equilibrators

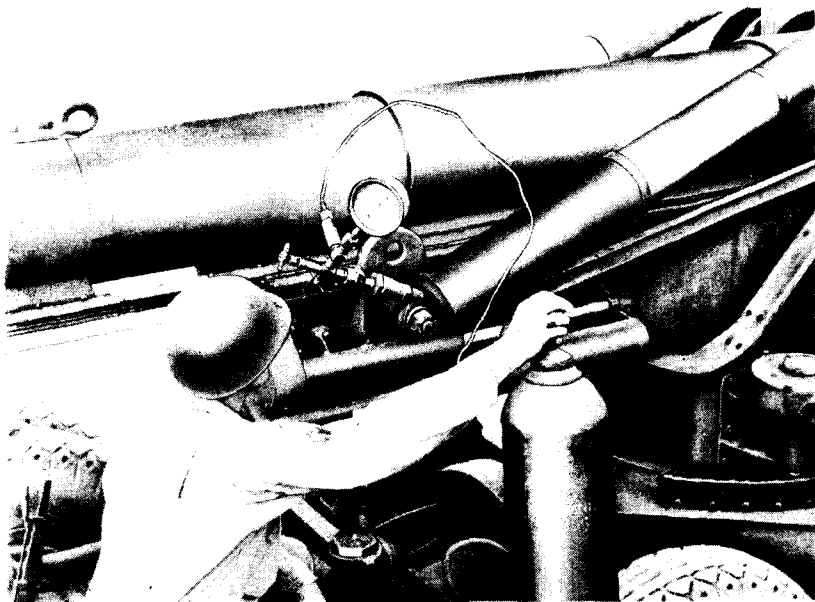
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RA PD 102423

Figure 99 — Section Through Equilibrator Cylinder

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RA PD 102387

Figure 100 — Charging Equilibrators With Nitrogen

temperatures. For satisfactory functioning, the equilibrators should be set for a temperature corresponding to the atmospheric temperature at the time of firing the gun. The adjustment may be made by trail since the scale is not correct if the equilibrator pressure is not normal. Operation of the temperature adjusting screw raises or lowers the guide and index along the temperature scale.

c. To measure the nitrogen pressure (figs. 100 and 101). **CAUTION:** *The nitrogen pressure in the equilibrators is normally about 1500 pounds per square inch at 70° F. Hence, every caution in the following steps on opening valves and plugs slowly must be observed. It is not advisable to check the nitrogen pressure unless it is evident that the equilibrators are not functioning properly. One grain of dust under the air filling valve will render an equilibrator unserviceable.*

(1) With the carriage approximately level, place the gun in battery and bring it to zero elevation. Check with gunner's quadrant.

(2) Remove the gas filling plug from the gas filling valve assembly in one equilibrator. **CAUTION:** *Remove the plug gradually to allow the escape of gas which, due to a faulty valve, may have built up a pressure against the plug.*

(3) Be sure that the air release valve and the tee cap on the air filling device are closed, and that the valve opener has been

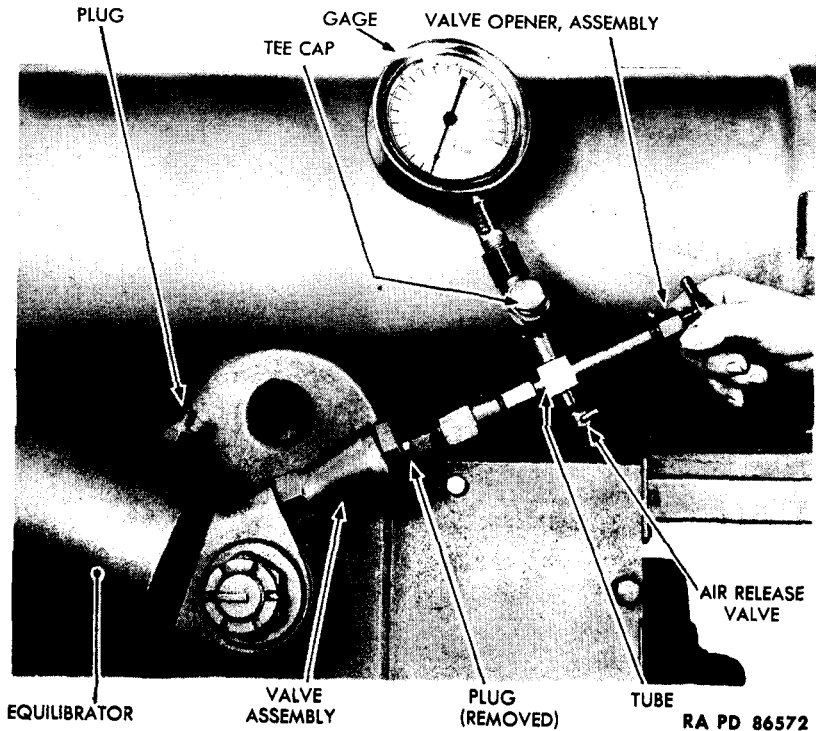
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Figure 101 — Checking Equilibrator Pressure

unscrewed until the point has been withdrawn into the body of the device.

(4) Screw the pressure gage in place in the air filling device.

(5) Screw the air filling device and gage into the gas filling valve assembly of the equilibrator from which the plug was removed. Before tightening the large nut on the filling device body, swing the body into such position that the tee cap will be readily accessible and the gage easily read.

(6) Force open the gas filling valve in the equilibrator by screwing in the valve opener. Tap the gage lightly to avoid error due to sticking of the band.

(7) The pressure in the equilibrator will now be indicated on the gage. The gage reading should coincide with the pressure required for the elevation of the gun and the atmospheric temperature as specified in the table below. The leeway allowed is 89 pounds above the specified reading, and 56 pounds below. (The tolerance on the lower limit is smaller than on the higher limit because about 15 pounds of pressure is lost during each test.)

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(8) If the pressure is more than 89 pounds above that given in the table for the charging temperature, partially open the air release valve and allow a slow escape of gas while tapping the gage lightly until the proper pressure is indicated. Close the air release valve. Unscrew the valve opener enough to close the gas filling valve. Open the air release valve slowly to let the nitrogen out of the air filling device and allow the pointer to go back to zero gradually. Remove the air filling device and gage. Install the gas filling plug and gasket. Tighten the plug fully.

(9) If the pressure is between the limits given in step (7), above, unscrew the valve opener enough to close the gas filling valve. Open the air release valve slowly to let the nitrogen out of the air filling device and allow the pointer to go back to zero gradually. Remove air filling device and gage. Install plug and gasket. Tighten plug.

Approximate equilibrator nitrogen pressure at different temperatures (gage pressure in pounds per square inch)

Temperature (degrees F)	Weapon at Zero-degree Elevation Equilibrator Extended
-40	1110
-20	1185
0	1308
10	1337
20	1366
30	1395
40	1423
50	1452
60	1481
70	1510
80	1539
90	1567
100	1596
110	1625
120	1710

d. To add nitrogen to the equilibrator. If the pressure is more than 56 pounds below the desired pressure, proceed as follows:

(1) Unscrew the valve opener enough to close the gas filling valve. Open the air release valve slowly and allow the pointer to go back gradually to zero.

(2) Remove the cap from the nitrogen cylinder. Use special cap removing tool or insert a metal bar in the slot in the cap. Connect one end of the flexible filling tube to the tee on the air filling tube, and the other end to the nitrogen cylinder valve (fig. 100). Be sure the air release valve is closed. Open the cylinder valve very slowly, tapping the gage lightly until it registers. The pressure of the nitro-

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gen cylinder registered on the gage should exceed the desired pressure in the equilibrator, as specified in the table.

(3) Close the cylinder valve. Screw in the valve opener, just far enough to allow the gage to register the pressure of the equilibrator. Tapping the gage lightly, slowly open the nitrogen cylinder valve to allow nitrogen to enter the equilibrator.

(4) When the pressure gage indicates a pressure slightly in excess (from 10 to 40 pounds) of that specified in the table for the temperature at which the filling operation is taking place, close the nitrogen cylinder valve.

Section XXII**BOGIE****82. DESCRIPTION.**

a. **General.** The two-axle dual-tired bogie supports the weight of the gun carriage when it is in traveling position and is equipped with mechanism for lowering the carriage to the ground for firing position. The carriage is raised for traveling or lowered for firing by means of the bogie lifting mechanism actuated by turning the two bogie lifting screws.

b. **Disassembly and assembly.** No disassembly or assembly of the bogie is permitted.

c. **Maintenance.** The bogie should be kept clean all over and lubricated properly. Tires should be cared for as outlined in paragraph 83.

Section XXIII**WHEELS AND TIRES****83. GENERAL.**

a. The bogie is equipped with four sets of dual-disk and rim-type wheels with pneumatic tires (fig. 102). The heavy carriage limbers are equipped with two single-disk and rim-type wheels with pneumatic tires. Disk and rim wheels of the limbers are interchangeable with the disk and rim wheels on the bogies. An alternate type of disk and rim wheel is issued with these units that is interchangeable with the present type used, provided the alternate disk and rim wheel is equipped with its proper tire locking ring. The tire locking rings of the regular-type disk and rim wheel and the alternate-type are not interchangeable.

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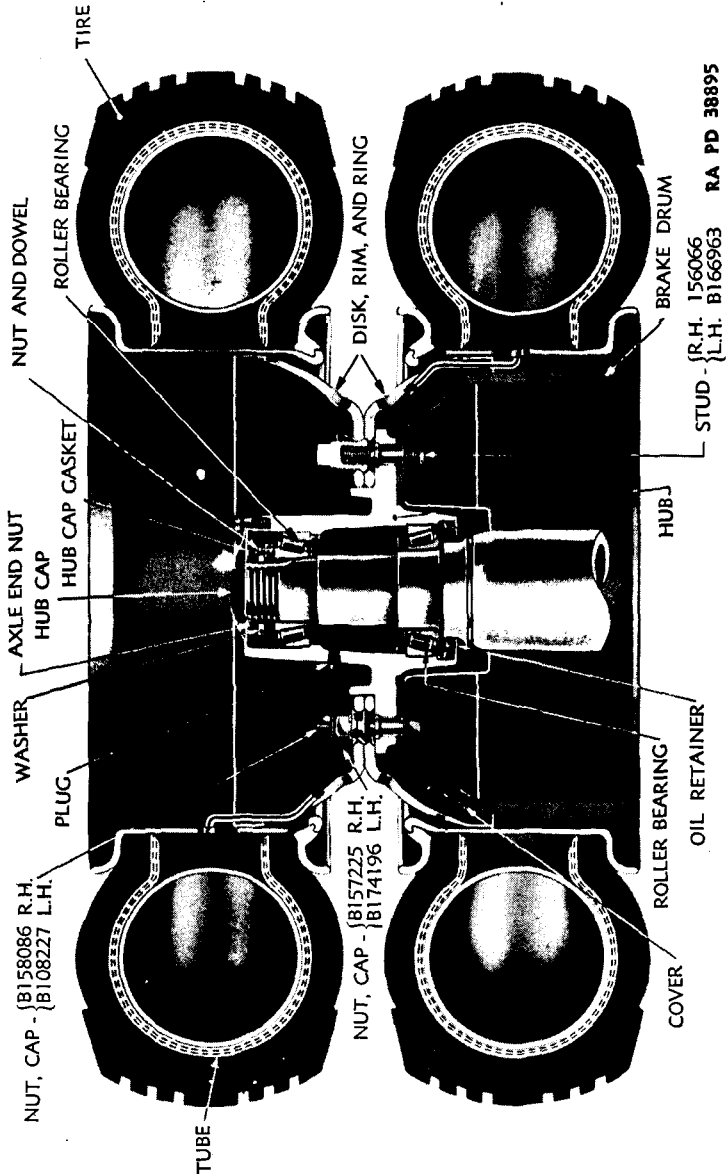


Figure 102 — Dual Wheel — Sectioned

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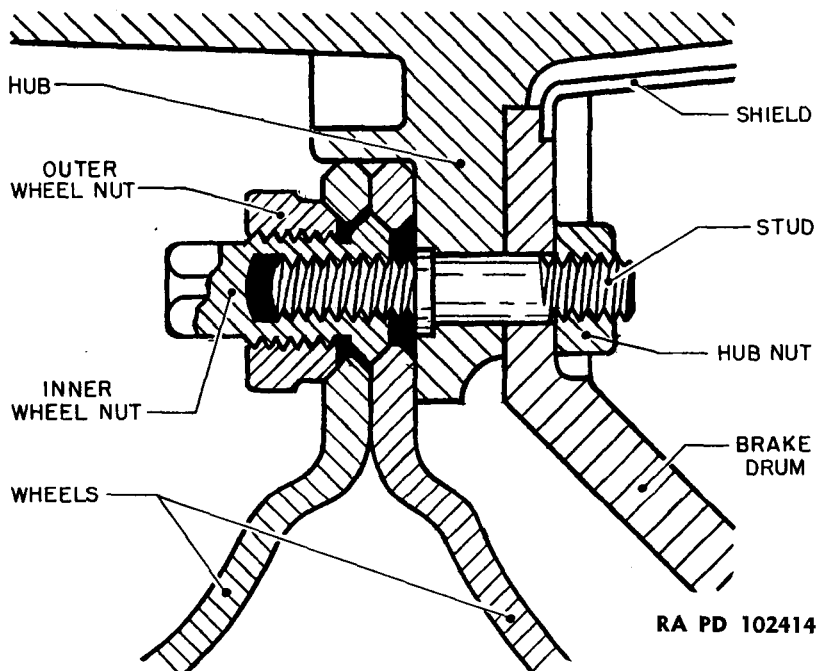


Figure 103 — Dual Wheel Mounting

b. To remove wheels and hubs.

(1) Raise the wheels clear off the ground by means of the jack provided, or by lowering the carriage to the ground and raising the bogie wheels with the lifting mechanism.

(2) **OUTSIDE WHEELS.** Remove cap nuts (fig. 103). Note right- and left-hand thread feature of the nuts.

(3) **INSIDE WHEELS.** Remove outside wheels as described. Remove cap nuts. Note left- and right-hand thread feature of the nuts.

(4) **HUBS.** Remove wheels as described. Remove the hub cap and its gasket by removing the six cap screws which secure them to the hub. Remove the axle and nut, the axle washer, and the axle nut and dowel. Withdraw the taper roller bearing. Remove the hub and brake drum, taking care not to damage the large roller bearing or the oil retainer at the inner end of the hub.

(a) Remove bearing cone assemblies from hub. Wash bearings, cones, spindle, and inside of hub, and dry thoroughly. Inspect bearing races and report to ordnance maintenance personnel if damaged. Coat the spindle and inside of hub and hub cap with prescribed grease to a maximum thickness of $\frac{1}{16}$ inch only, to retard rust.

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Lubricate bearings with a packer, or by hand, kneading lubricant into all spaces in the bearing. Use extreme care to protect the bearings from dirt, and immediately reassemble and replace wheel. Do not fill hub or hub cap. The lubricant in the bearing is sufficient to provide lubrication until the next service period; any excess might result in leakage into the drum.

(b) Thoroughly clean all component parts of the assembly. Place the large roller bearing cone and roller in its cup in the inner end of the hub. Place the oil retainer in the inner end of the hub with the lip of the sealing member toward the roller bearing. Carefully place the hub and bearing over the axle end. Put the smaller taper roller bearing cone and roller on the axle end, following it with the axle nut and dowel. Adjust the nut and dowel until the hub rotates freely but with no play. Place the axle washer in the keyway of the axle end and make any necessary slight adjustment of nut and dowel so that the dowel of the nut engages one of the holes in the washer, thereby locking the nut. Assemble and tighten the axle and nut against the axle washer. Put the hub cap and gasket back on the hub. Assemble the wheels to the hub.

c. Removal of tires and tubes.

(1) **DEFLATE TIRE.** Remove the wheels. Deflate the tire by removing the valve core to permit the tire locking ring to be removed.

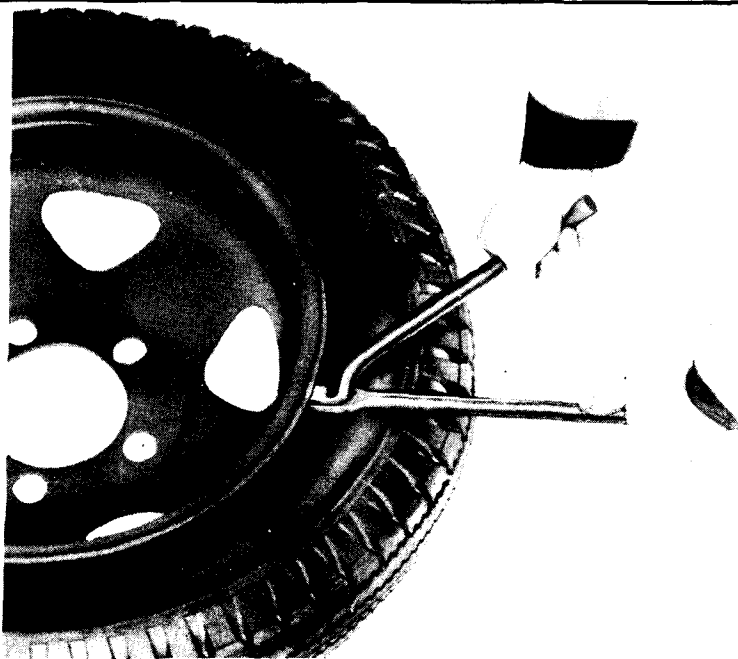
(2) **REMOVE TIRE LOCKING RING.** Figure 106 shows the tire locking ring and how it is locked in place. Force the locking ring down far enough to unlock it. Then with the ring tool in the breaking notch, pry the ring out over the rim flange. To avoid twisting the ring, pry only enough to clear the rim flange. Follow around with a tire iron until the ring can be lifted off.

(3) **LOOSEN TIRE FROM WHEEL.** Turn the wheel and tire over and force the tire bead away from the rim flange, using a tire releasing tool (fig. 104) or a blunt wedge and mallet.

(4) **REMOVE TIRE FROM WHEEL.** Place blocks under the wheel and push tire down off rim. If the tire is loose on the rim; it may be removed by hand with the wheel in a vertical position.

(5) **REMOVE INNER TUBE (fig. 105).** With a tire spreader, spread the casing to permit removing the tube. If a tire spreader is not available, wooden blocks may be used to hold the casing open while taking out the tube. If bullet-resisting tubes are used, they should be removed in a similar manner. Because of their heavier construction, however, it will be more difficult to remove them from the tire. Do not pull on the valve stem, as this may cause leakage of the valve. Do not use sharp objects to pry the tube out of the tire. A tool with no sharp edges may be used after removal has been started by hand. Bullet-resisting tubes should be partially

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RA PD 23391

Figure 104 — Loosening Tire From Wheel

inflated immediately after removing the tire to prevent the inside surfaces from sticking and sealing together.

d. Installation of tires and tubes.

(1) **INSPECT AND REPLACE PARTS.** Inspect the wheel and locking ring to see if they are bent or otherwise damaged, excessively worn, or unfit for service. Damaged tires, in many cases, can be repaired, while excessively worn tires and damaged inner tubes should be replaced.

(2) **INSTALL INNER TUBE.** Spread the tire casing with the tire spreader or wooden blocks to permit installing the inner tube. Deflate the inner tube and install it in the tire with the valve stem opposite the red dot on the side wall of the tire. Bullet-resisting tubes will be installed in a similar manner. Because of their heavier weight and greater thickness, however, they are more difficult to handle. *NOTE: After installing the tube, partially inflate and deflate several times to remove all kinks and folds.*

(3) **MOUNT TIRE ON WHEEL.**

(a) Insert the valve stem in the wheel slot, working the tire into position on the wheel. Soap may be used as a lubricant to aid in slipping the tire onto the wheel.

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RA PD 23393

Figure 105 — Removing Tube From Tire

(b) Place the tire and wheel flat on the floor (gutter side of rim up) with suitable blocking under the wheel to raise the tire just clear of the floor. Place the locking ring in approximate position above the rim gutter. Pry the locking ring into the rim gutter a little at a time, locking the notched end last.

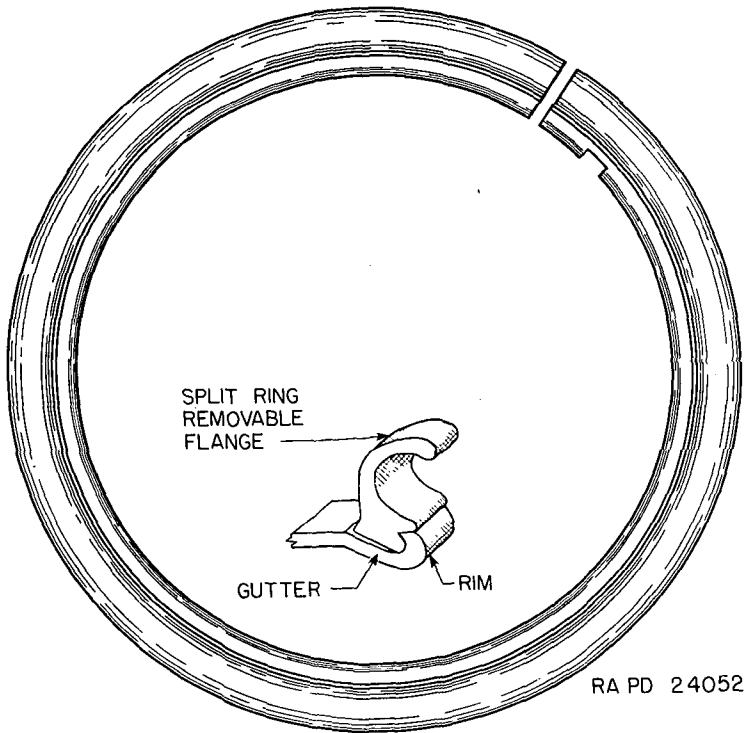
(4) **PARTIALLY INFLATE TIRE.** With wheel and tire assembly flat on the floor (locking ring up), partially inflate the tire and at the same time tap the locking ring at points around the rim to seat it properly. Do not overinflate the tire at this time; just a few pounds of pressure is enough to seat the locking ring in position.

(5) **INFLATE TIRE.** Place tire in normal vertical position and inflate from the side opposite the tire locking ring. **CAUTION:** *Stand to the side of the wheel and tire assembly, away from the tire locking ring, to avoid injury in case improper installation causes the locking ring to blow off.*

e. Maintenance of tire.

(1) AIR PRESSURE IN TIRES.

(a) Tires should be checked for proper readings and inflated when necessary to prescribed air pressure. The air pressure for the bogie tires under average conditions is 45 pounds. This air may be increased to 54 pounds when traveling over improved highways or

Part Three — Maintenance Instructions**Figure 106 — Tire Lock Ring**

decreased to 36 pounds when traveling over soft terrains. The air pressure for the limber tires under average conditions is 65 pounds. This air may be increased to 70 pounds when traveling over improved highways or decreased to 60 pounds when traveling over soft terrains. When checking pressures, check valve cores for leaks. Always use an accurate gage to determine air pressure. All air gages should be checked periodically with a precision-type gage. Never try to judge air pressure by the eye or by kicking a tire. Check pressure when tires are cool.

(b) Tires should never be bled (air let out) during or immediately after operation. Tires heat as they roll, and heat causes air to expand, which increases the pressure. Bleeding reduces air pressure, not the temperature. Bleeding actually makes tires run hotter, and may cause sudden, complete tire failure. When a bled tire cools, it is dangerously underinflated.

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(2) **VALVE CAPS ON ALL TIRES.** Equip every tire with a valve cap to prevent dirt from entering the valve core and causing leakage. In addition, a firmly screwed-down cap provides a final seal against air escaping from the tire. Tighten with fingers only; do not use pliers.

(3) **POSITION OF VALVE.** For speed and convenience in inflating, valve stems should be readily accessible. They should be properly centered in valve slots.

(4) **TIRES TO BE RETREADED.**

(a) Tires should be watched carefully, and then removed when the tread is worn off the center. If removed too soon, usable rubber is wasted. If removed too late, cord body may be injured, since it then lacks protection provided by the tread, or tire may be worn to the extent that retreading is impossible. It should be noted that tires are very easily punctured by studs left from wood and brush.

(b) When the tread design is worn off, so that the tire is smooth in the center, the tire should be replaced. Tires with irregular wear, worn to the extent that the cord body shows in any spot, or worn through the tread design in several spots, should likewise be replaced.

(5) **INJURED TIRES.**

(a) Tires are constantly subjected to injuries from cuts, bruises, and road shocks. It is dangerous to drive with an injured tire, because it may blow out any moment and cause the driver to lose control, and possibly put a much needed vehicle out of military action. Carefully inspect your tires after every run. Remove glass, nails, stones, and other foreign materials imbedded in tires.

(b) Always be on the alert against the following tire condition:

1. Replace when cuts extend to or into the fabric.

2. A bulge indicates internal injury. This injury may have been developing for some time. Replace in the event that cord fabric is injured or tire is otherwise damaged or has failed.

3. Small tread cuts, not extending to or into the fabric, is not reason to replace tire, but watch such cuts for penetration to cord body and enlargement, at which time the tire should be replaced. Large cuts, with exposure of cord fabric imminent, is reason for tire replacement.

(6) **IRREGULAR TIRE WEAR.** At the first sign of irregular wear, tires should be changed at different wheel positions, and immediate investigation of cause should be made by ordnance maintenance personnel.

(7) **TOE-IN MISALIGNMENT.** Tires wear rapidly when wheels are improperly aligned, and the telltale sharp or feathered edges appear on the tread. Front tires, especially, should be watched for rapid wear with sharp or feather edges. When this condition develops, ordnance maintenance personnel should be notified immediately.

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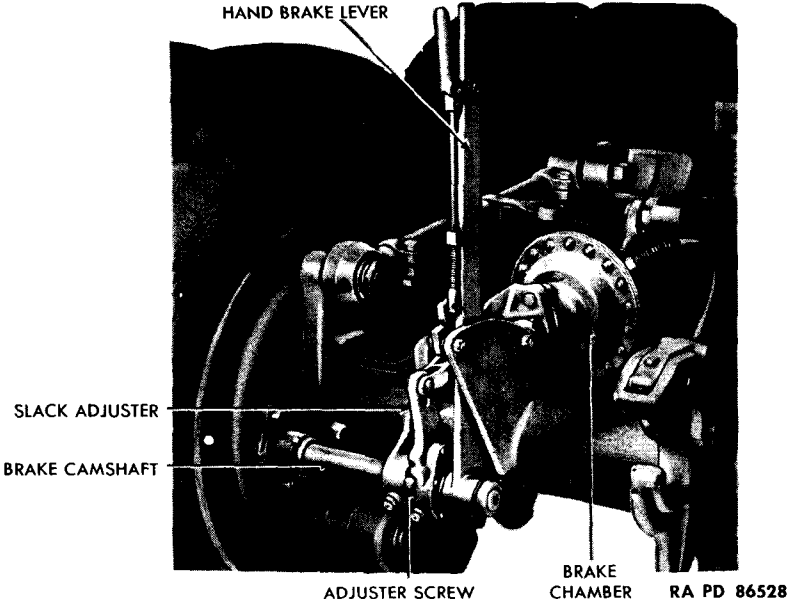


Figure 108 — Slack Adjuster

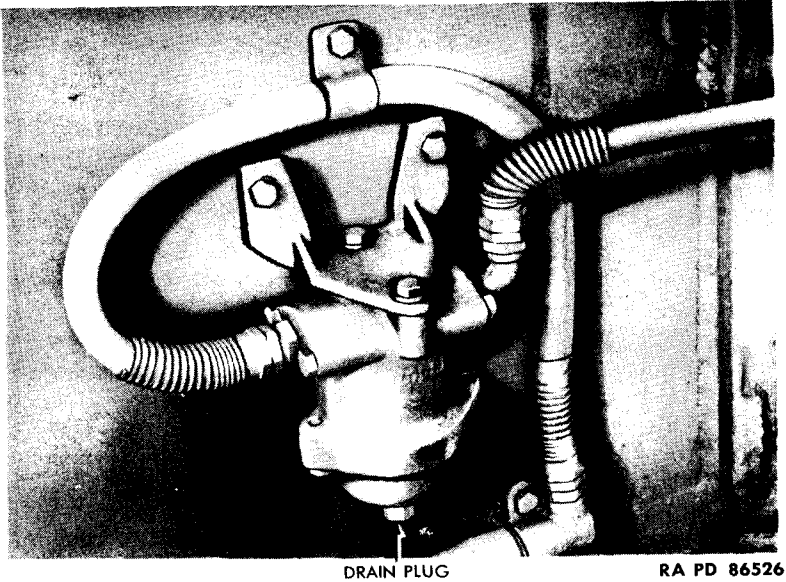
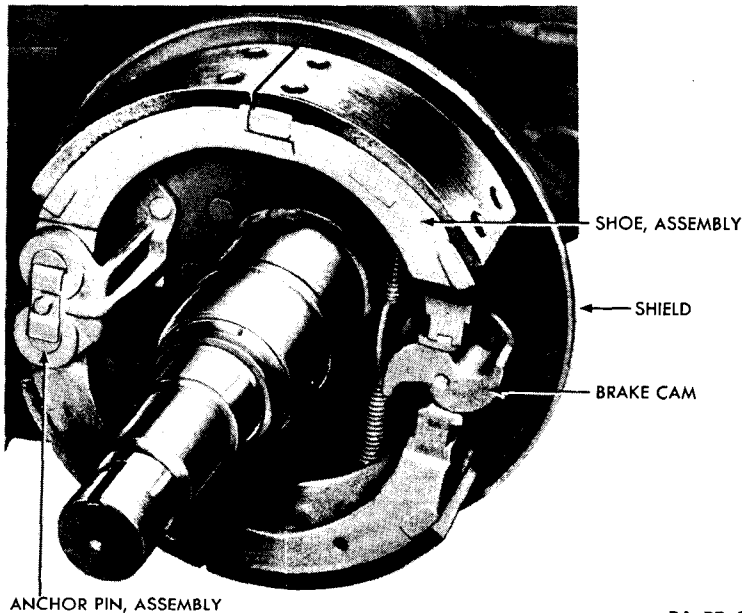


Figure 109 — Air Filter

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RA PD 86542

Figure 110 — Brake Shoes

air compressor to build up the pressure. As the pressure in the pilot reserve cavities in the relay-emergency valve becomes equalized, it presses up the emergency diaphragm in the relay-emergency valve so that the emergency valve resumes its normal operating position. In this position the diaphragm, pressed against its seat, seals the lower end of the cavity against the pressure in the upper part of the cavity and holds the emergency valve off its seat. This opens the brake chambers to atmosphere. The other method is to drain the air pressure from the reservoir by means of the drain cock provided.

b. Maintenance.

(1) **ADJUSTMENT** (fig. 108). Adjustment is accomplished by means of a slack adjuster at each wheel. Check the push rod travel by measuring the push rod with the brakes released, and then with brakes applied. If the push rod travel is in excess of $1\frac{3}{4}$ inches, adjust the slack adjuster. The most efficient brake action is obtained when the slack adjuster arm travel is held to a minimum so that the full length of the lever is used. The adjustment is accomplished by jacking up each wheel and tightening the slack adjuster until the brakes drag, then loosening it until the wheel just turns freely.

(2) **AIR FILTERS** (fig. 109). Air filters are located on the inside of the trails at their forward ends. The drain plugs should be re-

Part Three — Maintenance Instructions

moved weekly or any time the presence of moisture is suspected, and the moisture drained. The filter element should be removed monthly and washed in dry-cleaning solvent. Remove any rust or foreign matter from the interior of the body.

(3) **AIR RESERVOIR.** The air reservoir should be drained of accumulated condensation every 8 hours of travel in order to insure satisfactory functioning of the brake mechanism.

(4) **BRAKE DRUMS.** In order to prevent damage to the brake shoes, all accumulated dirt should be removed and the drums cleaned thoroughly with dry-cleaning solvent, whenever the wheel bearings are repacked.

(5) **COUPLINGS.** Every effort will be made to prevent the introduction of foreign matter into the air brake system when the air brake lines are disconnected from the prime mover. Air lines should be connected immediately to the dummy couplings provided, upon disconnection from the prime mover. If the coupling should touch the ground, the air line should be held with the coupling down and the air line tapped. Do not blow into the coupling as this will only move the sand or dirt from the coupling into the air line. **CAUTION:** *When it is necessary to stand on the bogie for any operation, care should be exercised not to trample upon or otherwise damage or cause breakage to air lines and air line connectors.*

Section XXV**HEAVY CARRIAGE LIMBERS****85. HEAVY CARRIAGE LIMBER M5.**

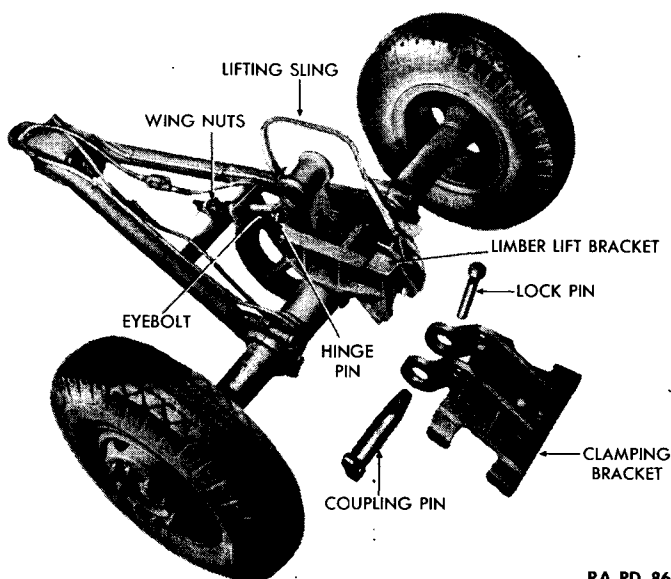
a. **General.** The heavy carriage limber M5 (fig. 111) may be used with the 155-mm gun carriage M1, in place of the heavy carriage limber M2. It is a two-wheeled, pneumatic-tired vehicle that secures the spade end of the trails, and provides a means by which the gun and carriage can be towed. While its function is the same as that of the limber M2, its construction is radically different.

b. **Description.**

(1) The principal parts of the limber M5 are the axle and wheels, the trail clamping bracket, the limber lifting bracket, and the drawbar with spring-loaded lunette.

(2) The limber lifting bracket is mounted on the axle, and forms a seat for the trail ends. The trails are raised to the lifting bracket by a lifting sling which operates in a lifting sling guide.

(3) The trail clamping bracket is bolted to the trail ends. The limber is moved into position so that the limber lifting bracket, which

Part Three — Maintenance Instructions

RA PD 86550

Figure 111 — Heavy Carriage Limber M5

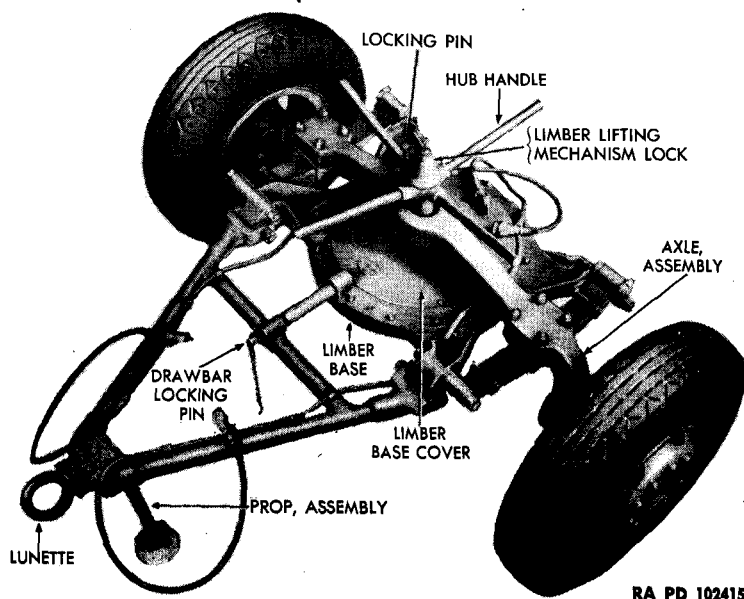
is mounted on the axle, can be attached to the clamping bracket by means of the coupling pin.

(4) The trails are raised to seat on the limber lifting bracket by means of a lifting sling operating in a lifting sling guide.

c. Removal and installation of limber. Removal and installation of the limber are discussed in paragraph 17.

86. HEAVY CARRIAGE LIMBER M2.

a. General. The heavy carriage limber M2 (fig. 112) used with the 155-mm gun carriage M1 is a two-wheeled pneumatic-tired vehicle which forms the connection between the carriage and the prime mover. The limber mounts the limber lifting mechanism. This mechanism is used for lowering or raising the spade end of the trails in placing the carriage in firing or traveling position. The end of the limber to which the drawbar is attached is considered the front end, since the limber is used only for traveling.

Part Three — Maintenance Instructions

RA PD 102415

Figure 112 — Heavy Carriage Limber M2**b. Description.**

(1) The principal parts of the limber are: the axle assembly, which mounts the limber wheels on antifriction bearings; the limber lifting mechanism base; the trail base; the limber lifting mechanism; and a standard-type drawbar with prop and lunette.

(2) **AXLE.** The axle is assembled with the two springs connected on each end by the spring shackle and lifting mechanism base pins to bearings that are integral with the base. The base forms the seat for the trail base and is provided with bearings for assembly of the drawbar.

(3) TRAIL BASE.

(a) The trail base, which turns in the limber lifting mechanism base, forms the turning point between the carriage and prime mover. The trail base seats the lifting mechanism on a thrust bearing and is provided with guide arms to locate the trails of the carriage when in traveling position.

(b) Trail locking pins on the trail base hold the ends together in traveling. The pins are locked by a plate engaging a groove in the pin.

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To withdraw the pin, turn it until the flat on the pin is in line with the plate. To engage the pin, reverse the operation.

(4) **LIFTING MECHANISM.**

(a) The limber lifting mechanism nut is threaded to fit the limber lifting mechanism center screw. The nut is rotated by means of hub handles. The lifting mechanism center screw pin, on the lower end of the center screw, engages mating bearings on the trail end, and does not revolve when raising or lowering the trails.

(b) The trails are raised or lowered by rotating the limber lifting mechanism nut. When in traveling position, the lifting mechanism must be locked in position to prevent vibration from causing a dropping of the trails. Two types of locks have been used for this purpose. One type of lock is mounted on the top of the axle. The locking is accomplished by placing the lock over one of the hub handles of the limber lifting mechanism. The other type of lock is a bell-shaped piece, free to slide up and down on the upper end of the center screw, when the limber lifting mechanism lock locking pin is actuated. The locking is accomplished by seating the lock on a hexagon-shaped hub nut on the top end of the limber lifting mechanism nut.

(5) When the materiel is not in the traveling position, the drawbar is locked to the lifting mechanism base by engaging the drawbar locking pin in the lifting mechanism tube on the base. This locking pin *must* be disengaged when the carriage is in traveling position.

(6) **WHEELS.** The limber wheels are identical and interchangeable with the bogie wheels. The limber wheels are of the single disk and rim type, whereas the bogie wheels are of the dual disk and rim type.

c. **Removal and installation of limber.** Removal and installation of the limber are discussed in paragraph 17.

d. **Disassembly, cleaning, and assembly of limber.**

(1) **DISASSEMBLY.**

(a) Sand entering the trail base and base of the heavy limber M2 causes cutting and burs on the bearing surfaces of these parts. The limber should be disassembled and washed with dry-cleaning solvent at least once a month. In sandy terrains this should be done more often.

Part Three — Maintenance Instructions

(b) The using arm is authorized to disassemble the heavy limber M2 for cleaning. Use the following procedure:

1. Remove the heavy limber M2 from the gun carriage. Pull limber to a dry, clean place where a hoist is available. Attach the drawbar to the hoist and tip the limber and axle to facilitate the removal of the trail base.

2. Remove the cotter pin which holds hexagon nut to the limber lifting screw. Remove the slotted nut from the lower end of the limber lifting screw and take off pin or cross head.

3. Remove the limber lifting screw and extension from the limber.

4. Remove the hexagon nut, lock washers, and machine screws holding the bronze plates to the base of the limber.

5. Remove the trail base and bronze liners from the base of the limber.

(2) **CLEANING.** To clean, proceed as follows:

(a) Wash the trail base, bronze liners, and limber lifting screw thoroughly with dry-cleaning solvent. Remove all burs with crocus cloth or a fine file.

(b) Wash out the bronze nut with dry-cleaning solvent to remove all grease and other foreign matter. Cover limber lifting screw with a light covering of No. 0, O.D. grease before assembling. Cover the bearing surface on the trail base with a light coating of No. 0, O.D. grease before assembling the limber.

(3) **ASSEMBLY.**

(a) Position the bronze plates to base of limber with machine screws, lock washers, and hexagon nuts.

(b) Secure plate in position.

(c) Assemble the limber lifting screw and extension.

(d) Install pin and cross head on lifting screw and secure with slotted nut and cotter pin.

(e) Lower the drawbar with hoist and disconnect hoist.

PART FOUR — AUXILIARY EQUIPMENT

Section XXVI

GENERAL

87. **SCOPE.** Part Four contains information for the guidance of the personnel responsible for the operation of this equipment. It contains only the information necessary to using personnel to properly identify, connect, and protect such auxiliary equipment while being used or transported with the main equipment. Detailed instructions pertaining to auxiliary equipment are contained in other Technical Manuals listed in section XXXI.

Section XXVII

AMMUNITION

88. **GENERAL.** Ammunition for the 155-mm guns M1 and M1A1 is of the separate loading type. The loading of a complete round requires three operations: loading the projectile, the propelling charge, and the primer. The components of a complete round, projectile, propelling charge, primer, and fuze, are shipped separately. The fuze is assembled to the projectile just prior to firing.

89. **FIRING TABLES.** Firing data is provided in the following: FT 155-S-2 and FT 155-Z-1. An index of firing tables is maintained in FM 21-6. Graphical firing tables are stored and reviewed in ORD SNL F-237.

90. **CLASSIFICATION.** Dependent upon the type of projectile, ammunition for this weapon is classified as high-explosive, armor-piercing, chemical, illuminating, target practice, and dummy. High-explosive shells are comparatively thin-walled and contain a high-explosive bursting charge. They are intended principally for fragmentation or mining effect. The armor-piercing projectile is thick-walled and contains a high-explosive bursting charge and base-detonating (BD) fuze. It is designed for penetration of armor plate. Chemical shells contain a chemical filler for producing either a toxic or irritating physiological effect, a screening smoke, an incendiary action, or any combination of these. Illuminating shell consist of an illuminating candle attached to a parachute unit, and an expelling charge, all encased in a steel shell. A time fuze ignites the expelling charge which ejects the burning candle suspended from the parachute and illuminates a desired point or area. The target practice projectile for use in this weapon is a sand-loaded shell of same design as the high-explosive shell. Dummy projectiles, which are completely inert, are intended for practice in loading and handling.

Part Four — Auxiliary Equipment

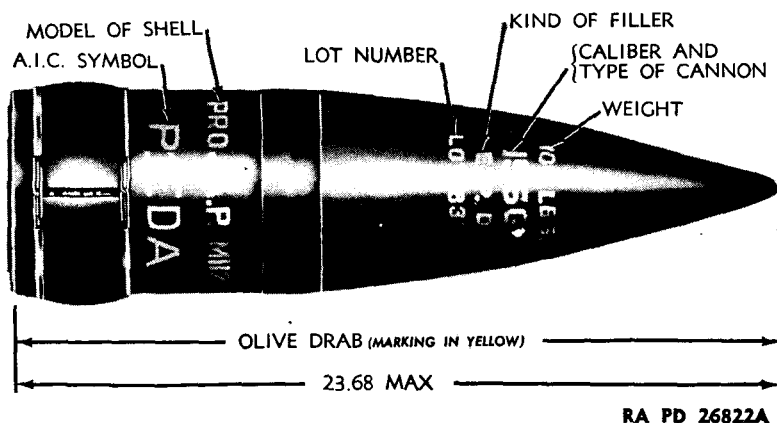


Figure 113 — AP Projectile M112

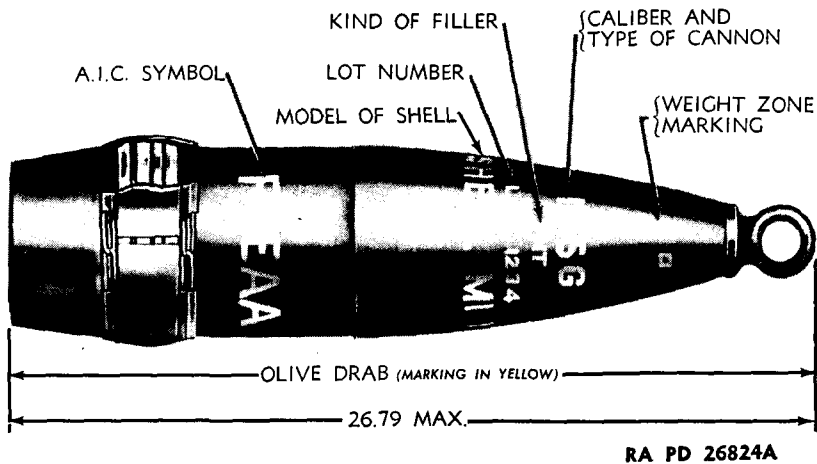
91. IDENTIFICATION.

a. General. The various rounds may be identified as follows:

Type of Projectile	Kind of Filler	Color of Body	Color of Markings	Other Distinguishing Characteristics
HE	TNT AMATO EXP. D	Olive drab	Yellow	None
Chemical	H (persistent gas)	Gray	Green	2 green bands painted around body of shell
Chemical	HC FS WP (smoke)	Gray	Yellow	1 yellow band painted around body of shell
Illuminating	Illuminant mixture	Gray	White	1 white band painted around body of shell
Target practice	Inert or none	Blue	White	None
Dummy	None	Black	White	1 red band painted around body of projectile at center of gravity

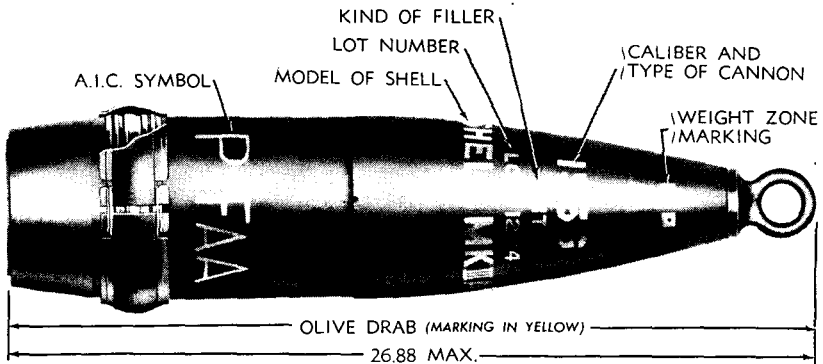
EXP. D — Explosive D
 FS — Chlorosulfonic acid-sulfur trioxide solution
 H — Mustard gas

HC — Hexachlorethane and zinc mixture
 HE — High explosive
 WP — White phosphorus
 TNT — Trinitrotoluene

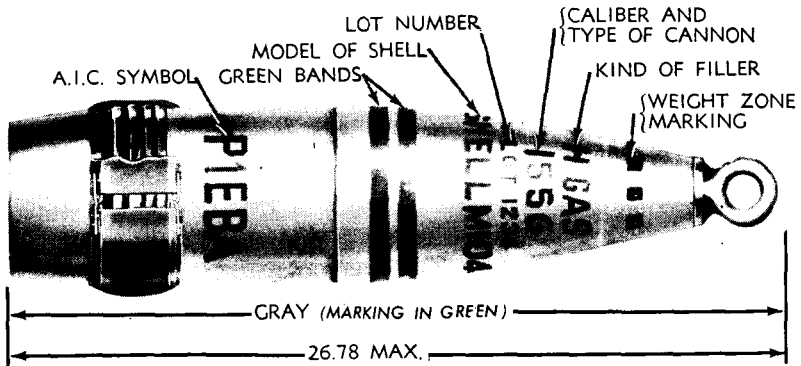
Part Four — Auxiliary Equipment**Figure 114 — HE Shell M101**

b. Lot number. A lot number is assigned all ammunition at the time of manufacture. This lot number is stamped or marked on each of the components unless the item is too small, and on all packing containers. It is required for all purposes of record, including reports on condition, functioning, and accidents in which the ammunition is involved. All components in any one lot of separate loading ammunition are manufactured under as nearly identical conditions as possible to ensure uniform functioning. Consequently, to obtain the greatest accuracy in firing, successive rounds should consist of projectiles of one lot number, propelling charges of one lot number, fuzes of one lot number, and primers of one lot number.

c. Weight-zone marking. It is not practicable to manufacture high-explosive shell within the narrow weight limits required for accuracy of fire. Therefore, they are grouped into weight zones and appropriate ballistic corrections are given in Firing Tables for the variation in weight. The weight zone of the shell is indicated thereon by squares of the same color as the original markings, with a prick-punch mark in the center of each. There are one, two, three, or more squares, dependent upon the weight of the shell. Four squares indicate standard or normal weight. A shell with this weight-zone marking does not require a Firing Table weight correction. Armor-piercing projectiles have weight to nearest pound stenciled on body and, therefore, do not require weight-zone marking.

Part Four — Auxiliary Equipment

RA PD 26823

Figure 115 — HE Shell Mk 3A1

RA PD 65117A

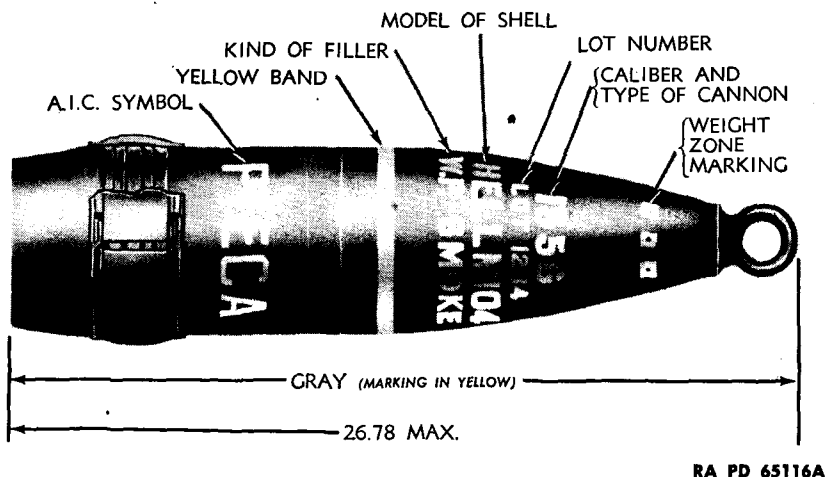
Figure 116 — H Persistent Gas Shell M104**92. CARE, HANDLING, AND PRESERVATION.**

a. Ammunition components are packed to withstand conditions ordinarily encountered in the field. All unfuzed high-explosive or chemical projectiles for the 155-mm guns M1 and M1A1 are fitted with an eyebolt lifting plug and a grommet. The armor-piercing and dummy projectiles are shipped one per crate. Fuzes, charges, and primers are packed in moisture-resistant containers. Since explosives are adversely affected by moisture and high temperatures, due consideration should be given to the following:

(1) Do not break the moisture-resistant seal until the ammunition is to be used.

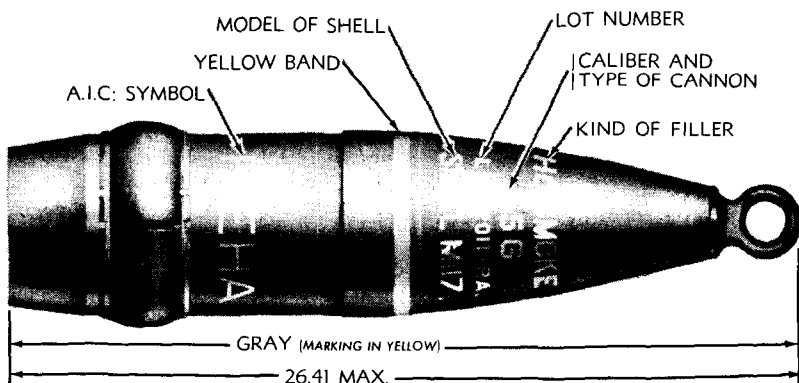
(2) Protect ammunition, particularly fuzes, from sources of high temperatures, including direct rays of the sun. More uniform firing is obtained if the rounds are at the same temperature.

Part Four — Auxiliary Equipment



RA PD 65116A

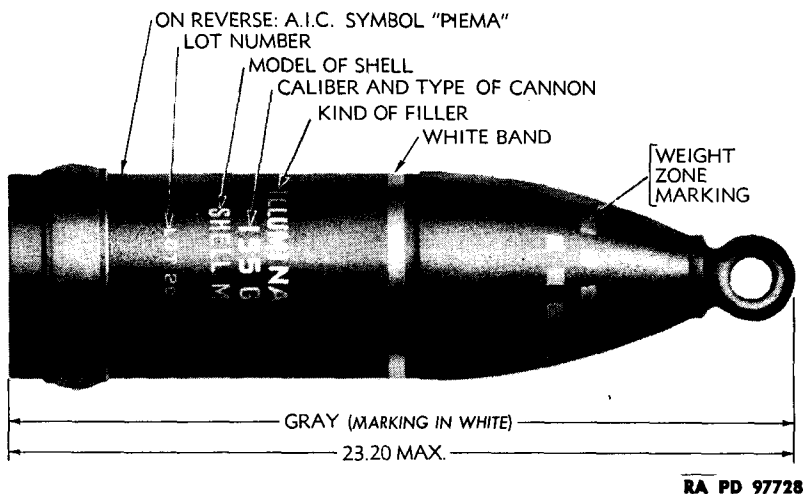
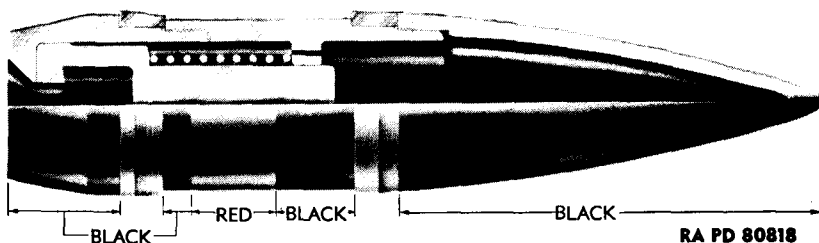
Figure 117 — WP Smoke Shell M104



RA PD 26819

Figure 118 — BE, HC Smoke Shell M117

- b. Do not attempt to disassemble any fuze.
- c. Do not remove protection or safety devices from fuzes until just before use.
- d. Before loading, each of the components should be free of foreign matter—sand, mud, moisture, grease, etc.
- e. *Explosive ammunition, or compounds containing explosive, must be handled with appropriate care at all times. The explosive elements in primers and fuzes are particularly sensitive to undue shock and high temperature.*
- f. Do not remove the eyebolt lifting plug from unfuzed rounds until the fuze is to be assembled thereto. The eyebolt lifting plug is

Part Four — Auxiliary Equipment**Figure 119 — Illuminating Shell M118****Figure 120 — Dummy Projectile M7**

provided for convenience in handling and to keep the fuze opening free of foreign matter.

g. Primers must always be stored in a dry place. Prolonged exposure to moisture or dampness may cause malfunctioning.

h. Components of rounds prepared for firing, but not fired, will be returned to their original condition and packings and appropriately marked. Such components will be used first in subsequent firings in order that stocks of opened packings may be kept at a minimum.

93. AUTHORIZED ROUNDS.

a. **General.** The ammunition authorized for use in this gun is listed in table I below. Table II lists complete rounds authorized for combat emergency use only and restrictions governing their use. In addition to the projectile, charge, and fuze listed in table I or II, the percussion primer Mk 2A4 is required for each complete round.

Part Four — Auxiliary Equipment

TABLE I
AUTHORIZED ROUNDS

PROJECTILE	FUZE FOR WHICH ADAPTED	PROPELLING CHARGE
Service Ammunition		
ARMOR PIERCING PROJECTILE, AP, M112, for 155-mm guns	FUZE, BD, M60	CHARGE, propelling, smokeless, 155-mm guns, M1 and M1A1
CHEMICAL		
SHELL, gas, persistent, H, M104, for 155-mm guns		
SHELL, smoke, FS, M104, for 155-mm guns	FUZE, PD, M51 series, w/booster, M21 series*	
SHELL, smoke, WP, M104, for 155-mm guns		
SHELL, smoke, HC, BE, M117, for 155-mm guns	FUZE, TSQ, M54	
HIGH EXPLOSIVE		
SHELL, HE, M101, for 155-mm guns	FUZE, PD, M51 series, w/booster, M21 series* or	CHARGE, propelling, smokeless, 155-mm guns, M1 and M1A1
	FUZE, TSQ, M55 series, w/booster, M21 series† or	
	FUZE, time, mechanical, M67 series, w/booster, M21 series§ or	
	FUZE, CP, M78 and booster, M25	

Part Four — Auxiliary Equipment

TARGET PRACTICE	Inert fuze, M51 series, M55 series, or M67 series, w/inert booster, M20 series, or M21 series	CHARGE, propelling, smokeless, 155-mm guns, M1 and M1A1 (only the base charge is authorized for use with this projectile)
ILLUMINATING	FUZE, TSQ, M54	
Dummy Ammunition		
PROJECTILE, dummy, Mk 1, 155-mm guns	NONE	CHARGE, propelling, dummy (21-lb base with 5½-lb increment), Mk 1, 155-mm guns
PROJECTILE, dummy, M7, for 155-mm guns		
PROJECTILE, dummy, M7, for 155-mm guns or howitzer		

*FUZE, PD, M51, w/booster, M21; M51A1, w/booster, M21A1; M51A3, w/booster, M21A2; or M51A4, w/booster, M21A4.

The following limitations apply to the M51 fuze and modifications:

FUZE, PD, M51 or M51A1, w/booster, M20A1, for service use until a sufficient supply of fuzes M51A3 with boosters M21A2 or fuzes M51A4 with boosters M21A4 are available; also for practice.

FUZE, PD, M51, w/booster, M21, or M51A1, w/booster, M21A1, for emergency combat use only; must be drop-tested prior to use.

†FUZE, TSQ, M55, w/booster, M21; M55A1, w/booster, M21A1; M55A2, w/booster, M21A2; or M55A3, w/booster, M21A4.

§FUZE, time, mechanical, M67 or M67A1, w/booster, M21A1; M67A2, w/booster, M21A2; or M67A3, w/booster, M21A4.

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TABLE II
AUTHORIZED ROUNDS FOR
COMBAT EMERGENCY USE ONLY

PROJECTILE	FUZE FOR WHICH ADAPTED	PROPELLING CHARGE
SHELL, HE, M101, for 155-mm guns or SHELL, HE, Mk 3A1, for 155-mm guns ¹	FUZE, PD, M51 series, w/booster, M21 series* or FUZE, TSQ, M55 series, w/booster, M21 series† or FUZE, time, mechanical, M67 series, w/booster, M21 series§ or FUZE, CP, M78 and booster, M25	CHARGE, propelling, smokeless, 155-mm guns, M1917-17A1-18MI ²
SHELL, HE, Mk 3A1, for 155-mm guns ¹	FUZE, PD, M51 series, w/booster, M21 series* or FUZE, TSQ, M55 series, w/booster, M21 series† or FUZE, time, mechanical, M67 series, w/booster, M21 series§ or FUZE, CP, M78 and booster, M25	CHARGE, propelling, smokeless, 155-mm guns, M1 and M1A1 ³
SHELL, gas, persistent, H, Mk 7A1, for 155-mm guns	FUZE, PD, M51 series, w/booster, M20 or M21 series*	CHARGE, propelling, smokeless, 155-mm guns, M1 and M1A1 ³
SHELL, gas, persistent, WP, Mk 7, for 155-mm guns	FUZE, PD, M46	

*FUZE, PD, M51, w/booster, M21; M51A1, w/booster, M21A1; M51A3, w/booster, M21A2; or M51A4, w/booster, M21A4.

The following limitations apply to the M51 fuze and modifications:

FUZE, PD, M51 or M51A1, w/booster, M20A1, for service use until a sufficient supply of fuzes M51A3 with boosters M21A2 or fuzes M51A4 with boosters M21A4 are available; also for practice.

FUZE, PD, M51, w/booster, M21, or M51A1, w/booster, M21A1, for emergency combat use only; must be drop-tested prior to use.

†FUZE, TSQ, M55, w/booster, M21; M55A1, w/booster, M21A1; M55A2, w/booster, M21A2; or M55A3, w/booster, M21A4.

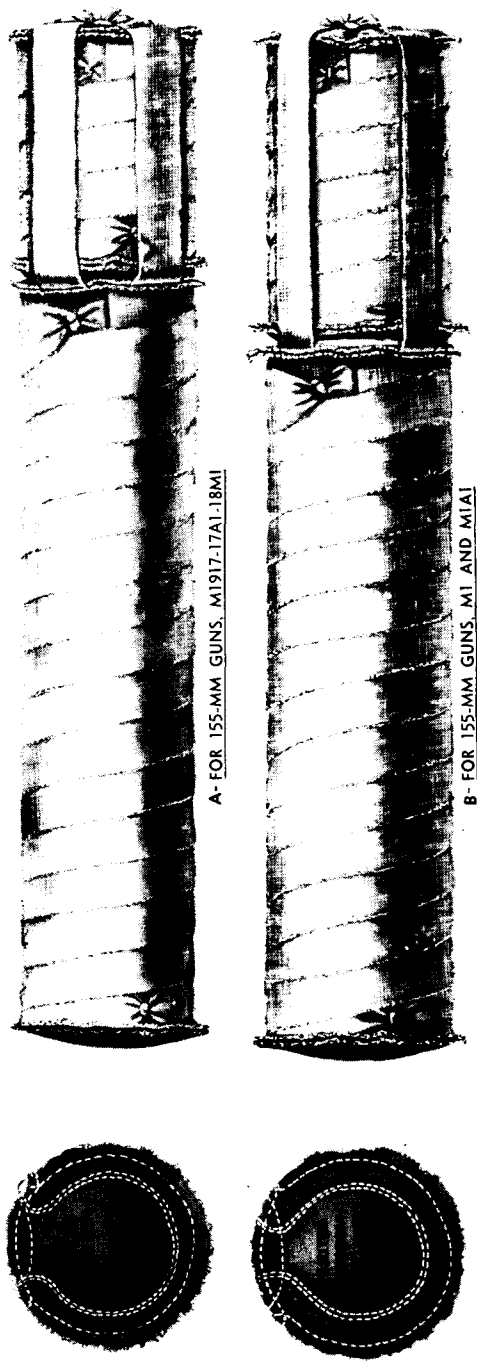
§FUZE, time, mechanical, M67 or M67A1, w/booster, M21A1; M67A2, w/booster, M21A2; or M67A3, w/booster, M21A4.

²Substitute standard for SHELL, HE, M101.

³Only the full charge is authorized for use in 155-mm guns M1 and M1A1. No firings will be made with only the base section.

⁴The SHELL, HE, Mk 3A1, should be fired with only the base section of this charge. The use of the full charge, in this case, is restricted to extreme emergencies.

Part Four — Auxiliary Equipment



RA PD 80881

Figure 121 — Separate-loading Propelling Charges for 155-mm Guns

Part Four — Auxiliary Equipment

TABLE III
CHARACTERISTICS OF PROJECTILES FOR 155-MM GUNS,
M1 AND M1A1

FIG. NO.	KIND	TYPE	MODEL	WEIGHT AS FIRED (lb)	CHARGE		LENGTH	
					Kind	Weight (lb)	As Shipped (in.)	As Fired (in.)
Service Ammunition								
113	PROJECTILE	AP	M112	100.00	EXP. D	1.44	23.68	23.68
114	SHELL	HE	M101	95.60	TNT	15.56	26.79	27.55
115	SHELL	HE	Mk 3A1	96.08	TNT	15.21	26.88	27.64
116	SHELL	Gas, persistent	M104	94.31	H	11.70	26.78	27.54
—	SHELL	Smoke	M104	99.51	FS	16.90	26.78	27.54
117	SHELL	Smoke, phosphorus	M104	98.21	WP	15.60	26.78	27.54
118	SHELL	Smoke (base ejection)	M117	94.73	HC	25.84	26.81	27.27
119	SHELL	Illuminating	M118	101.5	Illuminant candles	—	23.20	23.66
—	SHELL	Target practice	M101	95.60	Empty (for sand loading)	15.6	26.79	27.55
Dummy Ammunition								
—	PROJECTILE	Dummy	Mk 1	95.00	—	—	21.14	21.14
120	PROJECTILE	Dummy	M7 (for gun)	95.00	—	—	27.56	27.56
—	PROJECTILE	Dummy	M7 (for gun or how.)	95.00	—	—	27.56	27.56

b. Propelling charges. The propelling charge for the 155-mm guns M1 and M1A1 (fig. 121) is of the base and increment type. This charge should not be confused with the propelling charge for 155-mm guns M1917-17A1-18MI (fig. 121) which is authorized for combat emergency use only when used in guns M1 and M1A1. These charges differ in characteristics as indicated by the following table.

Fig. No.	For 155-mm Gun	Max. Length (in.)	Diameter (in.)	Length of Base Section (in.)	Length of Increment Section (in.)	Weight of Smokeless Powder Charge (lb)	Weight of Igniter (oz)
B, 121	M1 and M1A1	37.4	6.5	25.25	11.75	31.00	10.0
A, 121	M1917-17A1-18MI	37.0	5.8	28.50	8.50	25.00	8.0

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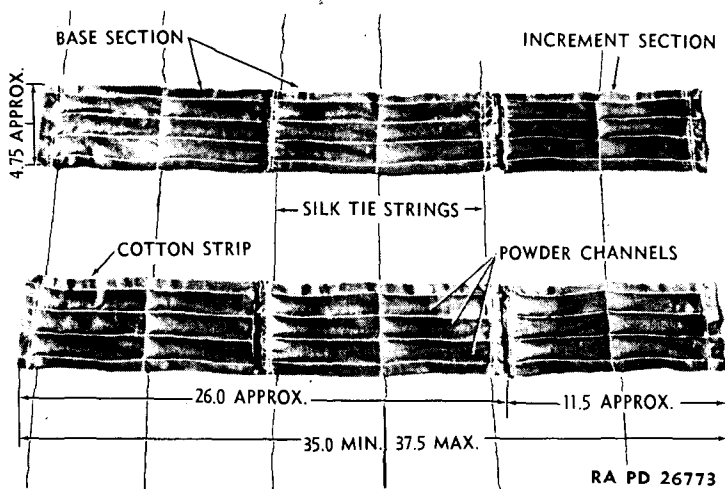


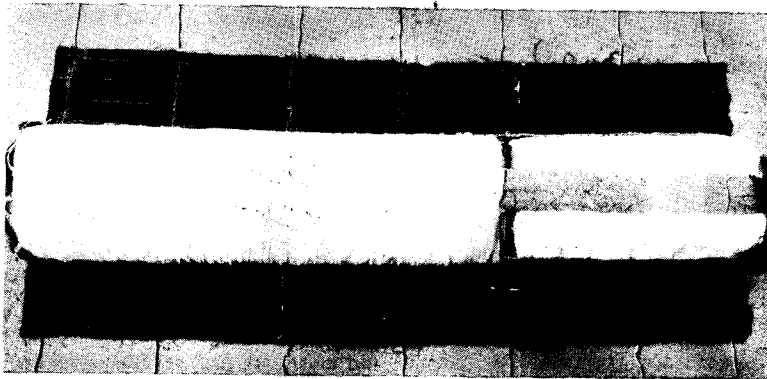
Figure 122 — Flash Reducer M1 (Base and Increment Section)

The propellant is smokeless nonhygroscopic powder and the igniter contains black powder. The igniter (cloth dyed red) is sewed to the rear end of base section. The increment section is attached to base section by means of four tying straps. The following identifying markings are stenciled on the charges:

ON BASE SECTION	
REAR	FRONT
"IGNITER"	"BASE"
Weight of igniting powder	Powder lot number
Caliber and model of cannon	Caliber and model of cannon
ON INCREMENT SECTION	
REAR	FRONT
Unmarked	"INCREMENT"
	Powder lot number
	Caliber and model of cannon

The full charge (base and increment) is known as the supercharge and is used only for extreme ranges. The base section only (increment section removed) is known as the normal charge and is used for all ranges up to the maximum obtainable with it. *The propelling charge for the M1917-18, 155-mm guns will always be fired as supercharge (base and increment) when used in 155-mm guns M1 and M1A1.* When inserting either charge into the gun, the igniter is held to the rear or breech end. An igniter protector cap is placed over the exposed igniter to protect it during shipment and storage; remove this cap be-

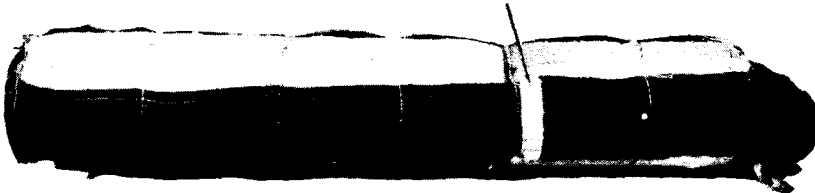
 Part Four — Auxiliary Equipment



RA PD 26774

Figure 123 — Propelling Charge (Supercharge) in Place on Flash Reducer

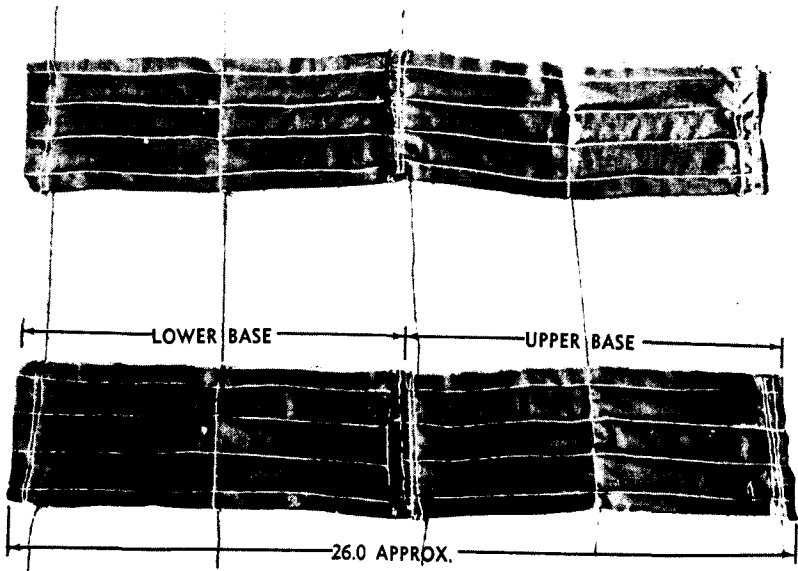
WHITE STRIP MARKS LINE BETWEEN
BASE AND INCREMENT SECTIONS



RA PD 26775

Figure 124 — Flash Reducer M1 Tied Around Propelling Charge

fore inserting charge into gun. The dummy charge simulates the service charge in size, shape, and weight. The flash reducer M1 (figs. 122 to 125) is supplied for use with these charges for night firing. It is tied around the propelling charge by means of silk tie strings. The flash reducer consists of two cotton strips (dyed scarlet) linked together with silk strings (fig. 122). Each strip contains three channels. The two outside channels of each strip contain a mixture of 60 percent potassium sulphate and 40 percent black powder. The center channel contains all black powder. Each strip is approximately 36 inches long and is divided into two sections; the base section containing the upper and lower base charges, and the increment section containing the increment charge. When using the flash reducer with the normal propelling charge, the increment section of each strip is removed and discarded. When using the supercharge, both base and increment sections of the strips are used. The increment section is approximately 11 inches long and is lightly sewed to the base section so that it may be ripped off. A piece of white cloth is sewed across the seam and serves as a convenient marker for the joint. Seven sets of silk strings

Part Four — Auxiliary Equipment

RA PD 26776

**Figure 125 — Flash Reducer M1 Prepared for Normal Charge
(Increment Section Removed)**

are attached to the outside edges of the two strips to provide for tying around the propelling charge. To use the flash reducer M1, proceed as follows:

- (1) When using supercharge:
 - (a) Remove one flash reducer M1 (pair of strips) from the packing and spread flat (fig. 122).
 - (b) Lay the propelling charge upon the strips so that it is even with both ends of the strips and is resting upon the strings which hold the two strips together (fig. 123).
 - (c) Tie the strips around the propelling charge by means of the strings, making certain that the strips are tied tightly to the charge (fig. 124).
 - (d) The propelling charge can now be used in the normal manner.
- (2) When using normal charge:
 - (a) Remove a flash reducer from the packing.
 - (b) Tear off and discard the increment section of the strips at the joint marked by the piece of white cloth. The sections can be ripped apart at this point (fig. 125).
 - (c) Spread the base section strips flat.

Part Four — Auxiliary Equipment

(d) Complete the operation by tying the base section strips around the normal propelling charge and following step (1) (b), (c), and (d), above. The effect of the use of the flash reducer is to increase the muzzle velocity by approximately 10 feet per second for the normal charge, and 25 feet per second for the supercharge, in the 155-mm gun M1917-M1918, and modifications. This correction must be applied when computing range data.

(3) **PRECAUTIONS.**

(a) The flash reducer M1 should be handled in the same manner as any other explosive charge.

(b) Use of the reducer M1 does not cause any appreciable additional powder fouling and, therefore, does not require any additional cleaning.

(c) When using the normal charge, the discarded increment section should be disposed of in accordance with existing regulations. See TM 9-1900.

c. Primers. The primer used (Mk 2A4) consists of a brass case containing a percussion element and approximately 19 grains of black powder. The percussion element in the head of the primer contains a sensitive explosive, hence, should be protected from any blows which might cause accidental functioning. A conical gas-check device prevents the passage of any propellant gas to rear into percussion element assembly. The function of the primer is to fire the igniter charge which is attached to the service propelling charge. In order that the primers may be readily accessible at the firing position, they are carried by cannoneers in a canvas belt. The primer belt is similar to a cartridge belt and is worn around the waist in a similar manner. It is constructed of canvas duck and is fitted with loops for 20 primers. Two pockets are also provided, one for the firing mechanism in use and one for the spare firing mechanism.

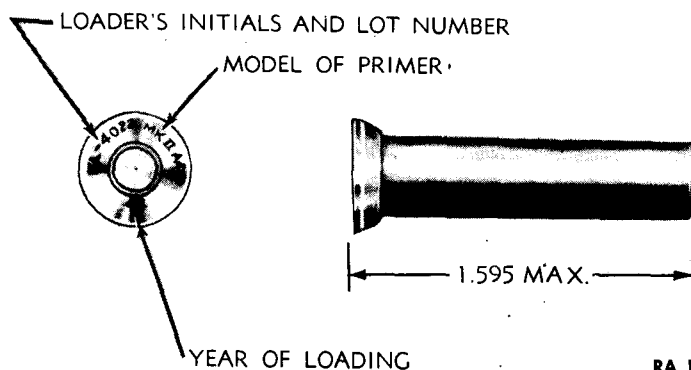
94. PREPARATION FOR FIRING.

a. Projectiles. Aside from removal of grommet and lifting plug, it is only necessary to fuze those shells which are shipped uncrated and unfuzed. The armor-piercing shell need only be taken from its box and the grommet removed to prepare it for firing. For method of assembling fuze to shell, see paragraph 95.

b. Propelling charges. After the charge has been removed from its moistureproof storage case, it is only necessary to remove the igniter protector cap and data tag. The charge must be loaded into the weapon with the igniter (cloth dyed red) toward the breech. When it is desired to fire less than the full charge, the tying straps are tied over the base charge. For night firing, assemble the flash reducer to the propelling charge, as described in paragraph 93 b.

c. Primers. To prepare a primer for firing, it is only necessary to insert it into the firing mechanism.

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RA PD 69092A

Figure 126 — Percussion Primer Mk 2A4

95. FUZES.

a. **General.** All fuzes discussed in following paragraphs are bore-safe. A bore-safe (detonator-safe) fuze is one in which the explosive train is so interrupted that, prior to firing and while the projectile is still in the bore of the gun, premature detonation of the bursting charge of the projectile is prevented, should any of the more sensitive explosives in the fuze, primer, and/or detonator malfunction.

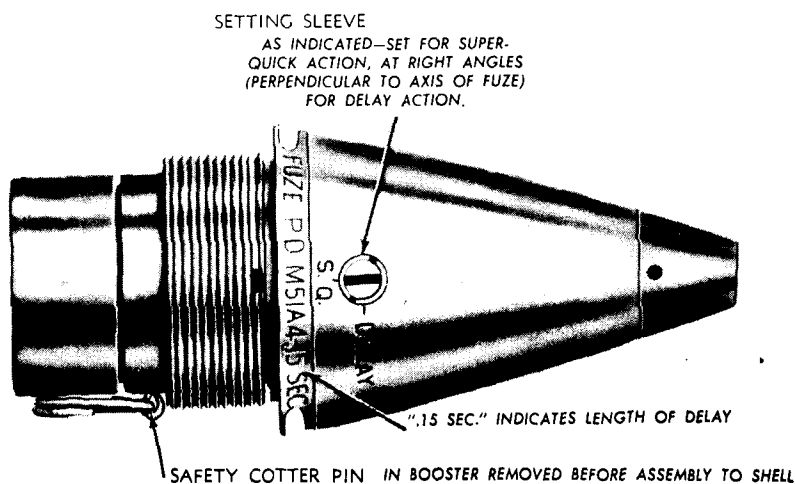
b. **PD fuzes M51 w/booster M21; M51A1 w/booster M21A1; M51A3 w/booster M21A2; M51A4 w/booster M21A4.***

(1) **GENERAL.** The fuzes and boosters making up these assemblies are essentially the same in principle but differ in various respects due to modifications of either the fuze or the booster, as follows: The M51A1 differs from the M51 internally with a resultant increase in reliability of functioning. The M51 and M51A1 differ from the M51A3 and M51A4 in the design of the plunger assembly. The latter types have a long plunger housing incorporating the delay firing pin so that the pin is rigidly supported. In the M51A3 and M51A4, the delay action is further modified to provide for a 0.15-second delay instead of 0.05-second as in the earlier models. The booster M21A2 assembled to the fuze M51A3 is also a modification of the earlier boosters, adding a set-back pin for additional insurance against premature or accidental functioning. The M21A4 is a further modification of the M21A2.

(2) **DESCRIPTION.** In all of the fuzes (fig. 127) the booster is permanently attached to the fuze at the time of manufacture. The fuze contains two actions, superquick and delay. When the fuze is set "DELAY," the superquick action is so interrupted that the projec-

*PD fuzes M51 w/ booster M21, and the M51A1 w/booster M21A1 are authorized for emergency combat only and must be drop-tested before use. The M51 or M51A1 w/booster M20A1 is authorized for service use until supplies of M51A3 w/booster M21A2, and M51A4 w/booster M21A4 become available.

Part Four — Auxiliary Equipment



RA PD 15053A

Figure 127 — PD Fuze M51A4 w/Booster M21A4

tile functions with delay action upon impact. It should be noted, however, that if the superquick action malfunctions upon impact when the fuze is set "SQ," the projectile will function with delay action rather than become a dud. On the side of the fuze near the base is a slotted "setting sleeve" and two registration lines; the one parallel to the axis is marked "SQ," the other "DELAY." As shipped, the fuze is set "SQ." To set the fuze for delay action it is only necessary to turn the setting sleeve so that its slot is aligned with "DELAY." A delay pellet, 0.15 second in the fuzes M51A3 and M51A4 and 0.05 second in the fuzes M51 and M51A1, incorporated in the delay action train provides for the delay action. The setting may be made or changed at will with a screwdriver or some other similar tool any time before firing. This can be done even in the dark by noting the position of the slot—parallel to the fuze axis for superquick action, at right angles thereto for delay. A cotter pin with pull ring is assembled to the booster to prevent accidental movement of the detonator during shipment.

(3) **PREPARATION FOR FIRING.** To fuze the projectile, proceed as follows:

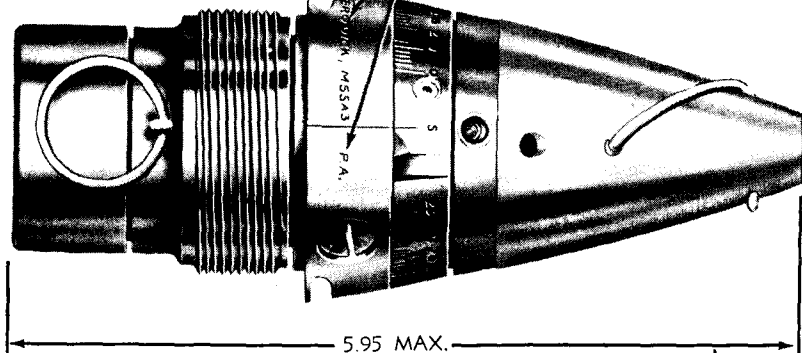
- (a) Remove eyebolt lifting plug from projectile.
- (b) Inspect fuze cavity and threads. They should be free of foreign matter which would interfere with the proper assembly of the fuze.
- (c) Remove cotter pin from booster.
- (d) Screw fuze booster assembly into projectile by hand. Tighten with fuze wrench.

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STAMPED ON REVERSE SIDE:
 LOADER'S LOT NUMBER
 LOADER'S INITIALS AND
 MONTH AND YEAR LOADED.

TYPE AND MODEL OF FUZE

MANUFACTURER'S INITIALS



RA PD 97727

Figure 128 — TSQ Fuze M55A3 w/Booster M21A4

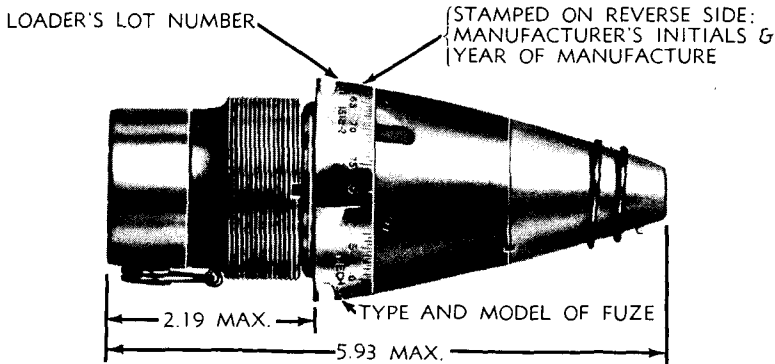
(e) Set fuze. If delay action is required, align slot in setting sleeve with "DELAY"; if superquick, align slot with "SQ" setting as shipped. Fuze may be reset as required.

c. TSQ fuze M54.

(1) DESCRIPTION. This fuze is a combination time and superquick type. A safety pull wire extends through the fuze to secure the time plunger during shipment. The fuze contains two actions, time and superquick. The superquick action is always operative and will function on impact unless prior functioning has been caused by time action. Therefore, to set the fuze for superquick action, it is required that the time action be set either at safe (S) or for a time longer than the expected time of flight. The time-train ring is graduated for 25 seconds. To prevent extremely short time action, an internal safety feature prevents the time action from functioning, should the fuze be set for less than 0.4 second. For reliable functioning the fuze should be set for at least 0.8 second. Functioning between 0.4 and 0.8 seconds is not reliable. The fuze as shipped is set safe; prior to firing, fuze is set for required time by means of a fuze setter.

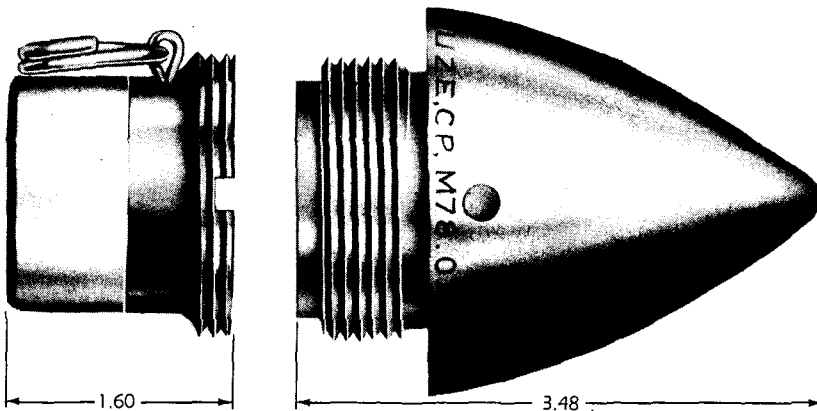
(2) PREPARATION FOR FIRING. After assembly of the fuze to the projectile and prior to firing, the safety pull wire must be withdrawn from the fuze for either superquick or time setting. To do this, pull lower end of the wire from the hole and slide wire off the end of the fuze. If superquick action is required, the graduated time-train ring can be left as shipped (set at safe), or set for a time greater than

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RA PD 97704

Figure 129 — Mechanical Time Fuze M67A3 w/Booster M21A4



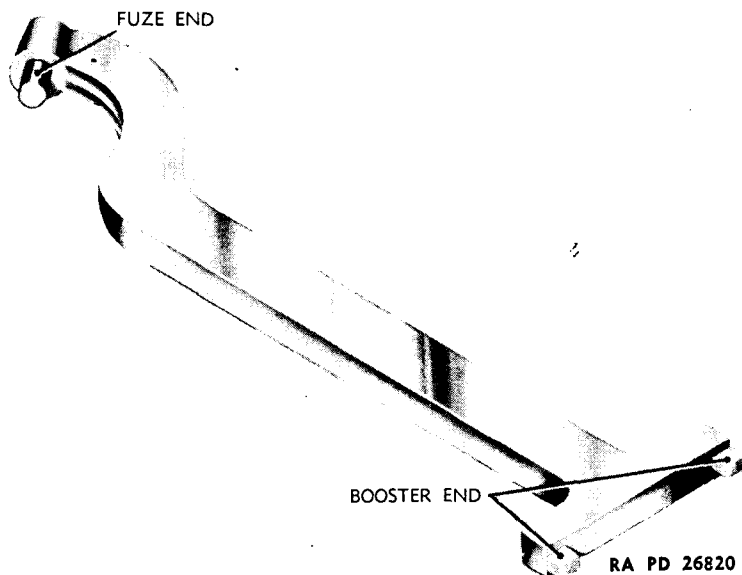
RA PD 104830

Figure 130 — Booster M25 and CP Fuze M78

the expected time of flight. If time action is required, the graduated time-train ring is set for the required time of burning by means of a fuze setter.

NOTE: If, after setting the fuze preparatory to firing, the round is not fired, the fuze will be reset safe and the safety pull wire replaced in its proper position, before the round is returned to its packing container.

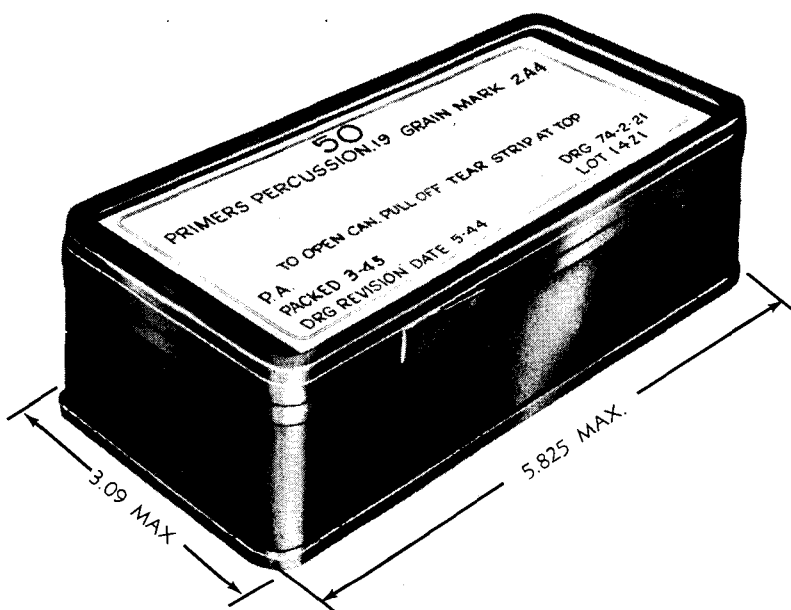
d. TSQ fuzes M55 w/booster M21; M55A1 w/booster M21A1; M55A2 w/booster M21A2; M55A3 w/booster M21A4. These fuzes (fig. 128) function in the same manner as the M54 with the one exception that the M55 series is issued with booster. The body of both the M54 and M55 fuzes are of identical design. The boosters are of the M21 series described in subparagraph b, above.

Part Four — Auxiliary Equipment**Figure 131 — Wrench for Fuze M78**

e. Mechanical time fuzes M67 or M67A1 w/booster M21A1; M67A2 w/booster M21A2; M67A3 w/booster M21A4.

(1) DESCRIPTION. The M67 and its modifications (fig. 129) are essentially alike and are intended to provide a means of high-burst adjustment at longer ranges when firing the high-explosive shell. The primary differences occur in booster modifications as described in subparagraph b, above. The fuze is of the mechanical (clockwork) time type, and is similar to the M43 type fuze in contour, and in design except that the escapement mechanism has been modified to give a longer running time. There is no impact element. The upper and lower caps are staked together and turn as a unit when setting the fuze. A set or register line is stamped on the rim of the lower cap. A safety line with "S" below it, and time graduations to 75 seconds with 0.5-second intervals, are stamped on the body. The graduations run counterclockwise, viewed from the point of the fuze. Two setting grooves, one each on the lower cap and body, are provided for setting the fuze. A safety feature is incorporated in these fuzes which prevents functioning of the fuze M67 should it be set for 3 seconds or less, and of the fuze M67A1, M67A2, or M67A3 should it be set for 1.5 seconds or less. As shipped, the fuze is set safe, that is, the set line in the lower cap is in alignment with the safety line "S" in the body. A pull wire is fitted to the fuze to secure the firing pin

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RA PD 97754

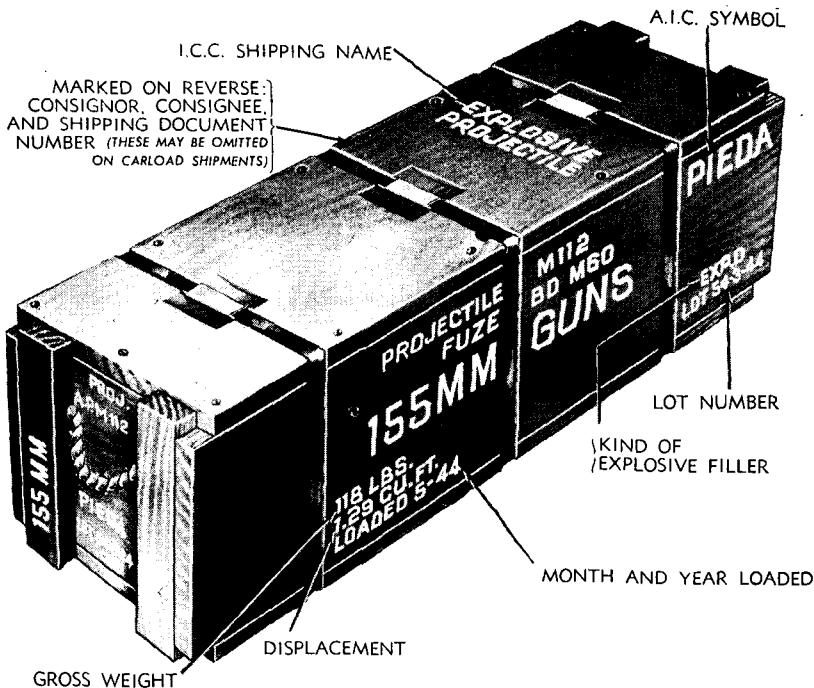
Figure 132 — Primer Packing Container

prior to firing. A cotter pin with pull ring is assembled to the booster to prevent accidental movement of the detonator during shipment. The booster is assembled to the fuze at the time of manufacture and handled thereafter as a single unit with the fuze, in shipment and assembly to the projectile. The cotter pin is to be withdrawn just prior to assembling the fuze with booster to the shell.

(2) **PREPARATION FOR FIRING.** To fuze the projectile, proceed as follows:

- (a) Remove the eyebolt lifting plug from the projectile.
- (b) Inspect the fuze cavity and threads. They should be free of foreign matter which would interfere with the proper assembly of the fuze.
- (c) Remove the cotter pin from the booster.
- (d) Screw the fuze booster assembly into the projectile by hand. Tighten with the fuze wrench.
- (e) Remove the safety pull wire. This can be done readily by pulling the end of the wire from the hole in the lower cap and sliding the wire off the end of the fuze.
- (f) Set fuze by means of fuze setter, the lower cap being turned in a counterclockwise direction as viewed from the point of the fuze. The torque required to set the fuze is between 80 and 100 pound-inches.

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RA PD 65118

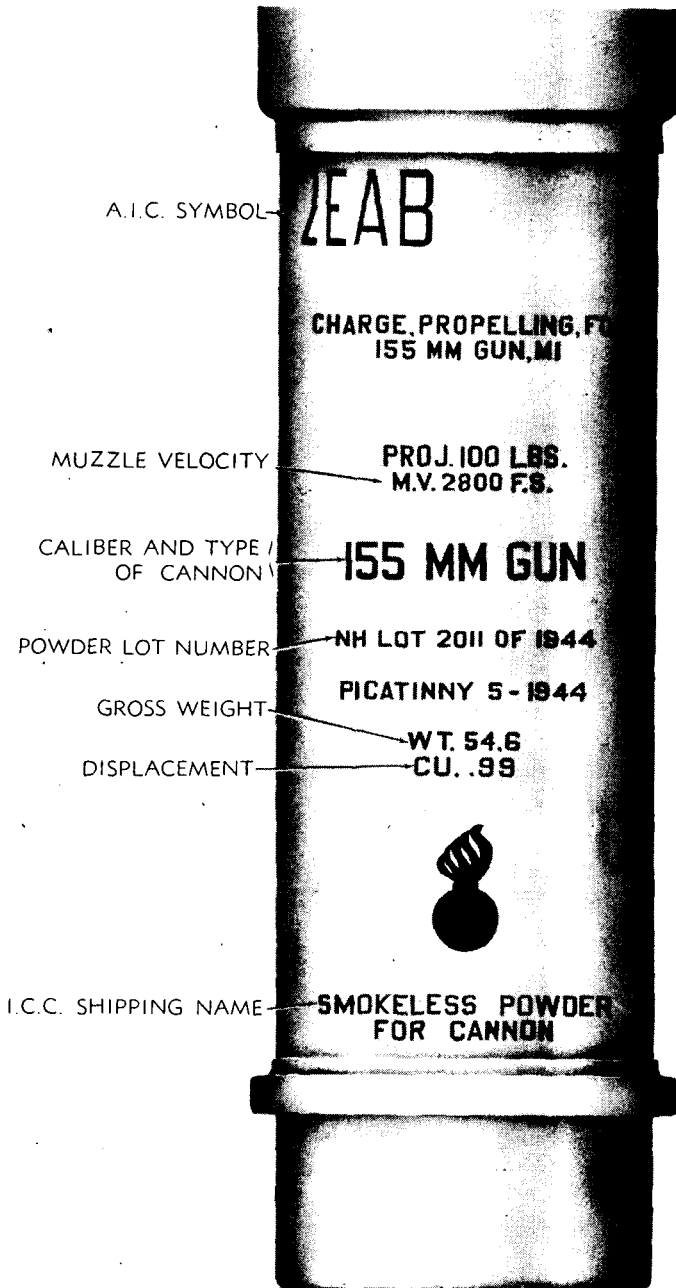
Figure 133 — Packing Box for Projectile M112**f. CP fuze M78 and booster M25.**

(1) **DESCRIPTION.** The concrete-piercing fuze M78 and booster M25 (fig. 130) are used to convert the HE shell M101 or Mk 3A1 into a shell capable of penetrating concrete or other heavy targets. In this case both the fuze and booster are shipped in the same container but as separate components. The fuze is a solid hardened steel nose plug which contains a detonator assembly in its base. It is shorter and heavier than the fuzes described in paragraphs above. A delay element of 0.025 second is contained in the detonator assembly. No delay setting is used since this is a delay fuze only. The booster M25 is a modified booster M21A4 containing approximately three external threads rather than six. A cotter pin with pull ring, which is located in the booster body, must be removed prior to assembly of the booster to the shell. This booster is intended for use only with the CP fuze M78.

(2) **PREPARATION FOR FIRING.** After removal of lifting plug from projectile, proceed as follows:

(a) Remove the safety pin from the booster M25 and screw the

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RA PD 65119

Figure 134 — Cartridge Storage Case M16

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booster into the booster cavity in the shell. Tighten booster firmly with the booster end of the wrench (fig. 131) which is issued with the fuzes M78.

(b) Screw the fuze M78 into the fuze cavity and tighten securely with fuze end of wrench. Be sure that the fuze shoulder seats firmly against the nose of the shell; there should be no space between shoulder of fuze and shell. Do not stake fuze to the shell.

96. PACKING.

a. **General.** Complete packing data covering dimensions, volume, and weight of the various components of the ammunition described herein are published in ASF Catalog ORD 11 SNL's P-1, P-2, P-8; for subcaliber ammunition, the information is published in R-1 and R-3. Although weight of individual projectiles varies somewhat, dependent upon the type and model — propelling charges likewise, dependent upon the particular powder charge — the data given in table IV are considered representative for estimating weight and volume requirements.

b. **Marking for shipment.** Packing for shipment, and bundle packing identification and shipping plates, are marked as follows (figs. 132 to 135):

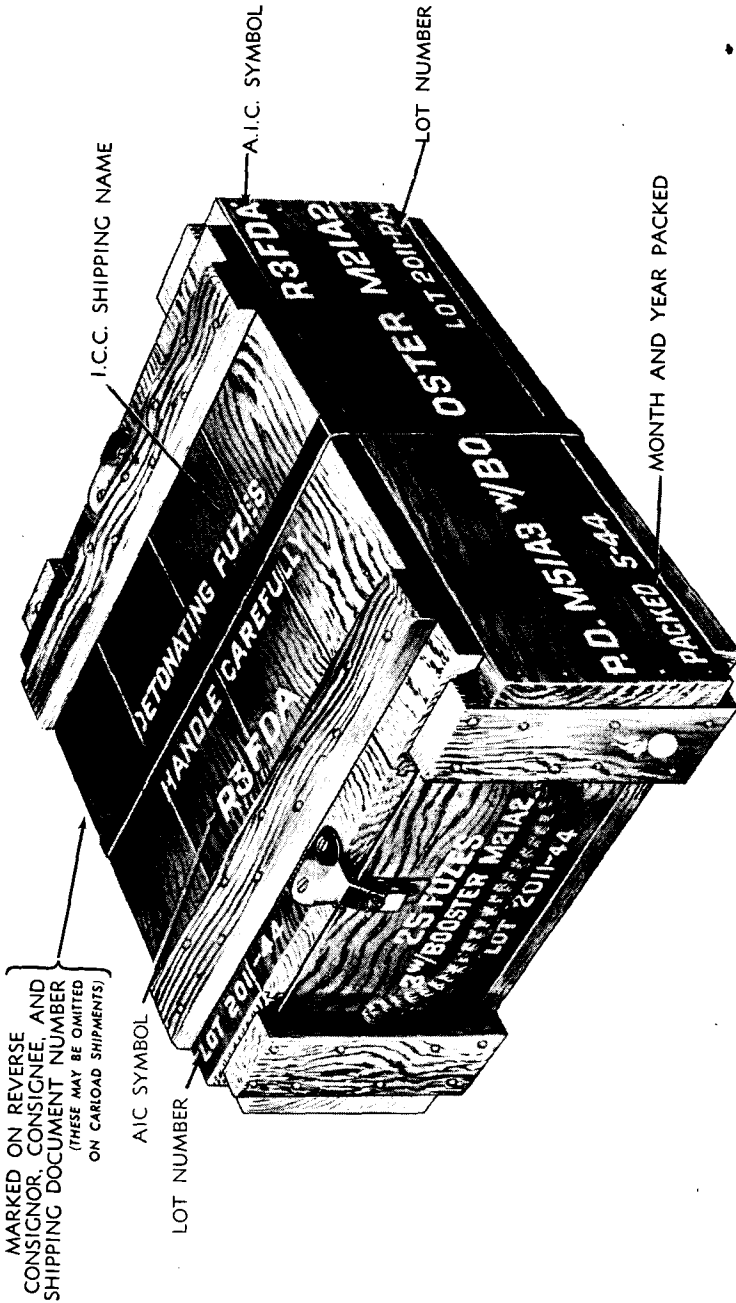
- (1) Name and address of destination or port officer.*
- (2) Name and address of ultimate consignee (or code marking).*
- (3) List and description of contents.
- (4) Ammunition Identification Code (A.I.C.) symbol, as published in SNL's.
- (5) Gross weight in pounds, displacement in cubic feet.
- (6) The number of the package.*
- (7) The letters "U.S." in several conspicuous places (not mandatory).
- (8) Order number, contract number, or shipping number.
- (9) Ordnance insignium and escutcheon.
- (10) Name or designation of consignor preceded by the word "From."*
- (11) Lot number.
- (12) Month and year loaded.
- (13) Inspector's stamp.

97. SUBCALIBER AMMUNITION.

a. **General.** Ammunition authorized for subcaliber purposes is illustrated in figure 136. All rounds are issued in the form of fuzed

*May be omitted on individual package in carload shipments of packages of standard weights and dimensions containing standard quantities.

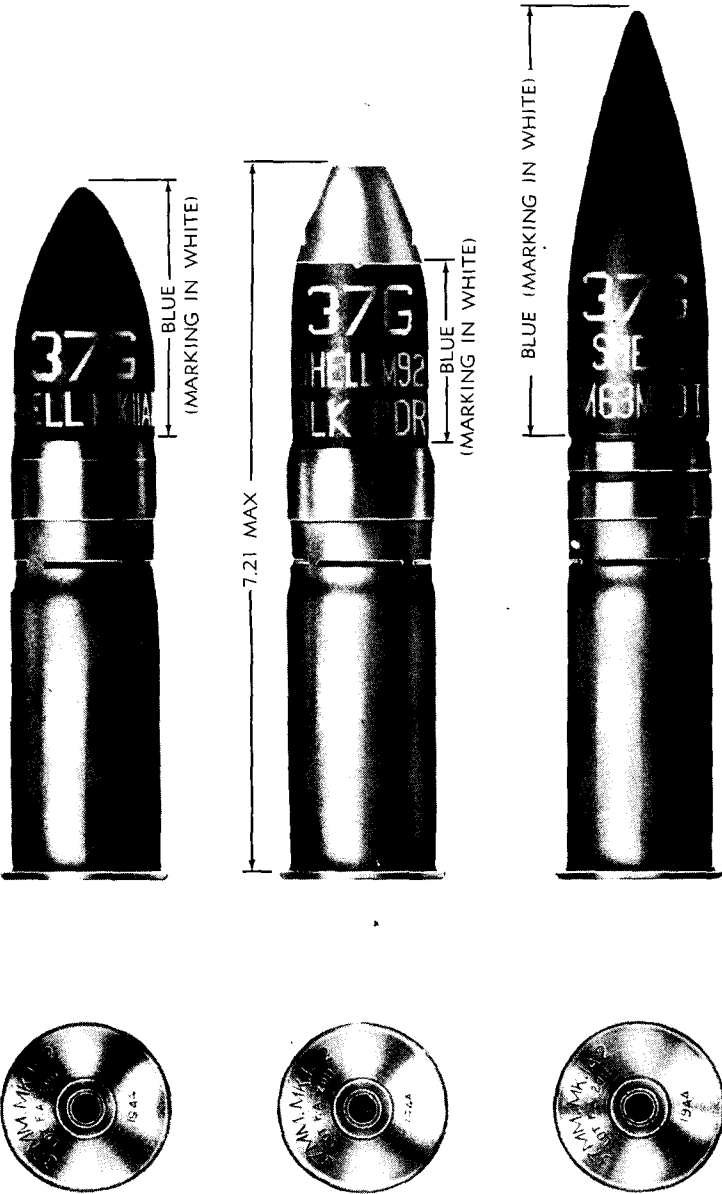
Part Four — Auxiliary Equipment



RA PD 65142A

Figure 135 — Representative Marking of Packing Box for Fuzes

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RA PD 23099

Figure 136 — Ammunition for 37-mm Subcaliber Guns

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complete rounds of fixed ammunition and have a black powder spotting charge. The shell M92 is fitted with a point-detonating fuze, whereas the others have base-detonating fuzes. The shell Mk 2A1 will be issued only until present stocks are exhausted. This shell (Mk 2A1) may be fired in the exterior mounted subcaliber guns, provided personnel are not located forward of line through the muzzle; this shell *will not* be fired in the in-bore subcaliber gun.

b. **PD fuze M74.** The M74 is a recent model of point-detonating fuze containing a direct-action firing pin and a Semple-type rotor which acts as an interrupter. The fuze is provided for use with the practice shell M92 (shown fitted to shell in figure 136). It is used to ignite the black powder spotting charge and does not require or have a booster. The fuze is of the impact type and is considered bore-safe.

TABLE IV
PACKING DATA

ITEM	INNER CONTAINER	OTHER PACKING	NO. OF ITEMS CONTAINED	WEIGHT (lb)	VOLUME (cu ft)	OVER-ALL DIMENSIONS (in)
High explosive, chemical and target practice shell	—	Uncrated, with vulcanized fiber steel grommet and lifting plug	—	97.0 (aver. wght.)	0.68	2.23 x 0.55 diameter
Armor-piercing projectile	None	Wooden box	1 projectile	118.0	1.29	2.35 x 0.74 x 0.74
Dummy projectile	None	Wooden crate	1 projectile	106.0	2.02	2.80 x 0.85 x 0.85
Propelling charge for 155-mm guns M1 and M1A1	None	Cartridge storage case	1 charge	54.6	1.60	3.56 x 0.67 x 0.67
Propelling charge for 155 - mm gun M1917-17A1-18MI	None	Cartridge storage case	1 charge	46.3	1.32	3.52 x 0.61 x 0.61
Fuzes	Individual container	Wooden box	20 fuzes	41.0	0.79	1.04 x 0.54 x 1.39
Primers	Metal container (contains 48 primers)	Wooden box	1440 primers	95.5	1.94	1.98 x 1.16 x 0.79

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c. **Packing.** The rounds are packed in individual fiber containers which, in turn, are packed 40 per wooden box. Complete packing data will be found in SNL R-1.

98. FIELD REPORT OF ACCIDENTS. See paragraph 2 b in section I.

Section XXVIII**SIGHTING AND FIRE CONTROL EQUIPMENT****99. SIGHTING AND FIRE CONTROL EQUIPMENT.**

a. The telescope mount M18A1 equipped with the panoramic telescope M12 or M5A5 (fig. 137) is the sighting element for laying the gun in azimuth. No provision is made in this mount for setting off quadrant elevation or range, as this is accomplished with the gunner's quadrant placed on the quadrant mount M1.

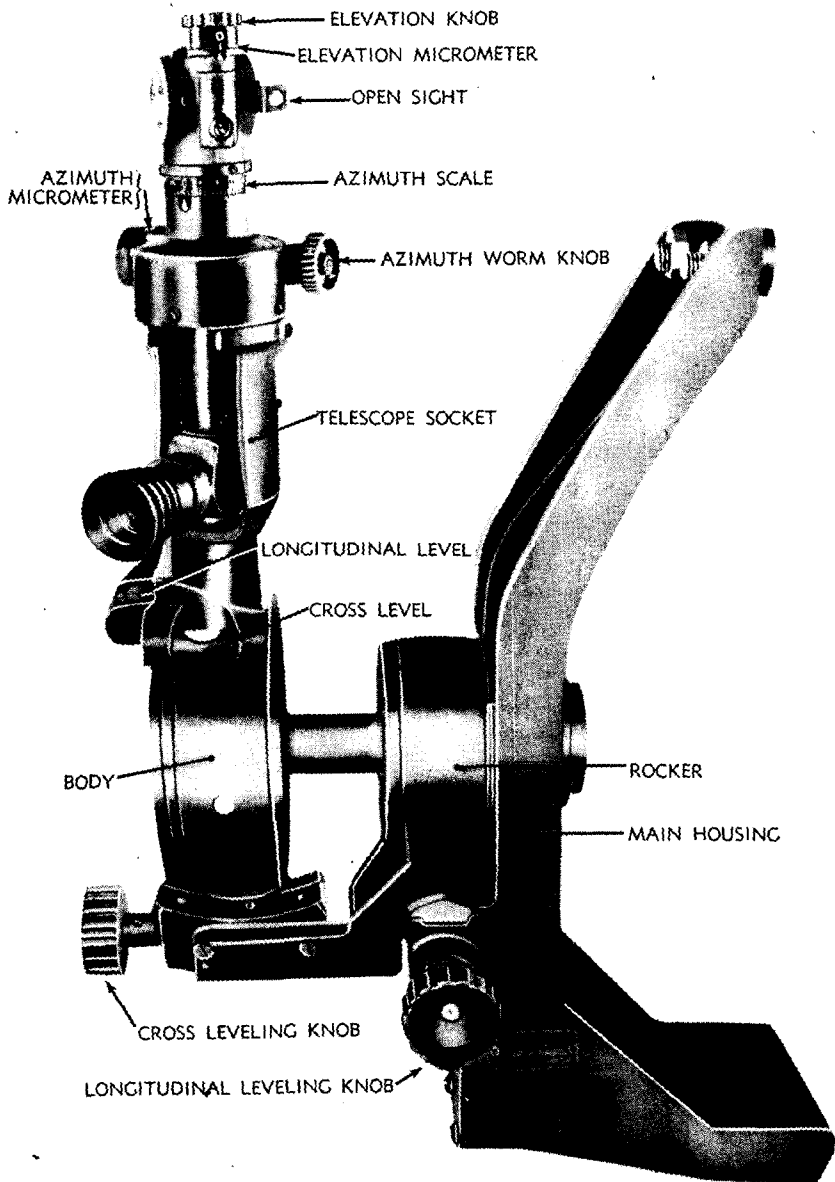
b. **Off-carriage equipment.** The telescope mount, telescope, quadrant mount, and instrument light are covered in this section. TM's covering off-carriage instruments are covered in section XXXI.

100. TELESCOPE MOUNT M18A1 WITH PANORAMIC TELESCOPE M12 OR M5A5.**a. Description:**

(1) The telescope mount (fig. 137) contains longitudinal- and cross-leveling mechanism. The cross level is habitually kept centered by operating the cross-leveling knob. The centering of the cross-level bubble automatically introduces an azimuth correction which compensates for any error produced when the gun is elevated with the trunnions out of level. The longitudinal level is operated by the elevating knob. The centering of the longitudinal-level bubble places the azimuth scale of the telescope in a true horizontal plane, so that azimuth angles can be set accurately.

(2) The panoramic telescope M12 (fig. 138) is provided as standard for the 155-mm gun materiel M1. It is a conventional panoramic telescope with eyepiece offset 45 degrees to permit the observer to stand clear of the gun. The telescope has cylindrical locating surfaces at the middle and bottom for centering the telescope in its socket. The line of sighting is elevated or depressed by the elevation knob at the top, and coarse and fine index graduations register the normal position (zero elevation). The head is moved in azimuth by the azimuth worm knob. A throw-out lever permits disengagement of the azimuth worm for rapid motion when required. Azimuth angles are measured on an azimuth scale and micrometer. The azimuth scale is graduated in 100-mil intervals, and indicates progres-

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RA PD 31553

Figure 137 — Telescope Mount M18A1 With Panoramic Telescope M12

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sively from 0 to 32 in two consecutive semi-circles. The micrometer indications (1-mil intervals) supplement the indications on the azimuth scale. The reticle pattern (fig. 139) consists of cross lines and a deflection scale graduated in 5-mil intervals and numbered at 50-mil intervals.

(3) The panoramic telescope M5A5 is different in appearance from the panoramic telescope M12 in that the lateral deflection scales and micrometer, and the eyeshield are changed. The panoramic telescope M5A5 has no lateral correction scale. Their operation is essentially the same.

(4) The instrument light M19 (fig. 140) is provided for illuminating the reticle, scales, and indexes of the panoramic telescope M12 and the level vials of the telescope mount M18A1. It is a self-contained light with power supplied by two dry-cell batteries, a control switch, and clamps for mounting the light.

b. Operation.

(1) **EMPLACEMENT OF TELESCOPE.** To place the panoramic telescope in the socket on the mount, turn the wing knob on the mount to its extreme counterclockwise position and place the telescope gently in the socket. Exert slight downward pressure to ensure that the telescope is properly seated. Release the wing knob. Uncover both levels. Turn on the illumination if necessary.

(2) **CROSS LEVELING.** Keep the telescope mount cross-leveled at all times during the operation of both direct and indirect fire, otherwise the telescope reticle lines will erroneously move off the target as the gun is elevated and an incorrect azimuth setting will be applied to the gun.

(3) **DIRECT FIRE.** Observing through the telescope, bring the target to the graduation on the reticle representing the desired lead or deflection by turning the traversing handwheel on the carriage. It may be necessary to rotate the elevation knob on the telescope to bring the target into the field of view; this will have no effect in laying the gun in elevation when the quadrant mount is used.

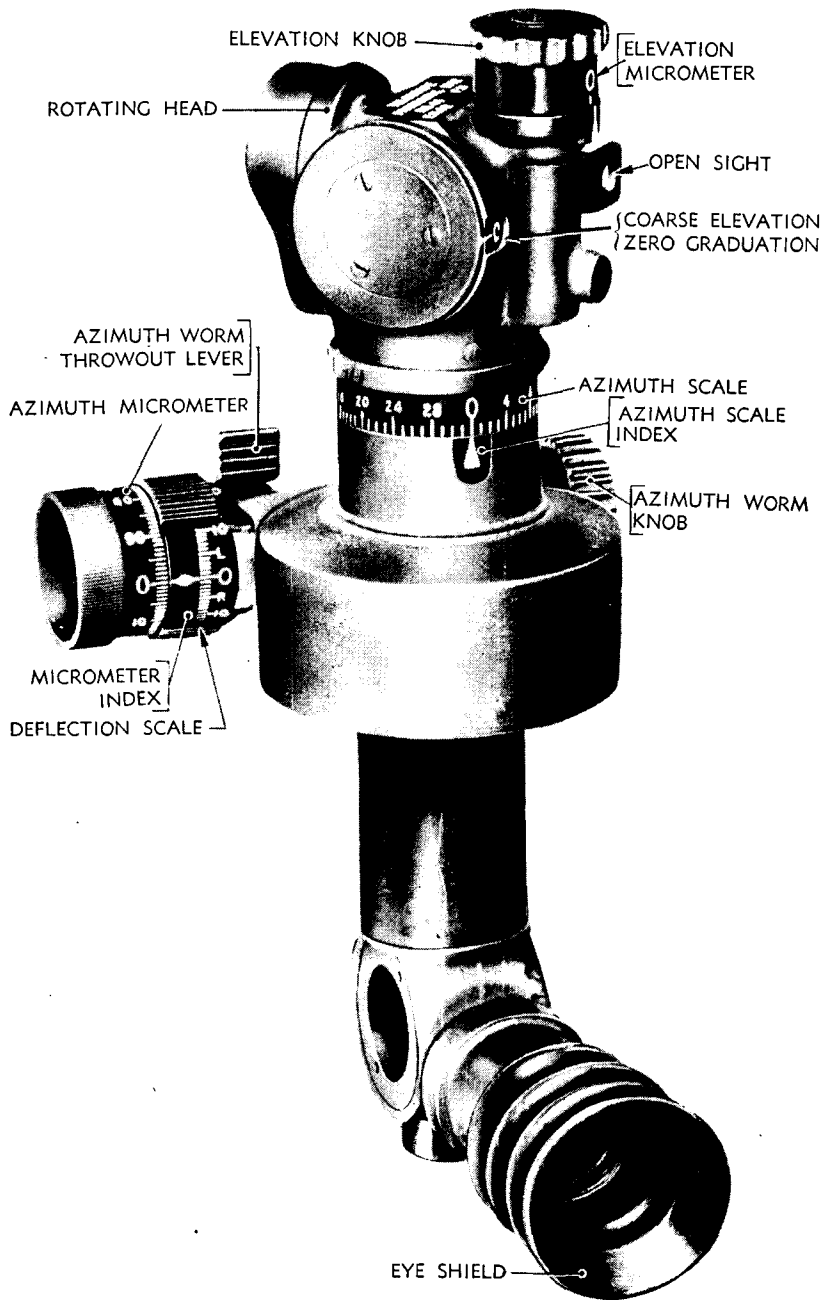
(4) **INDIRECT FIRE.** Set the firing azimuth on the azimuth scale and micrometer of the panoramic telescope. Traverse the gun carriage until the vertical line in the telescope reticle falls on the aiming post. Keep the mount cross-leveled and longitudinally-leveled. Use the elevating knob on the telescope to bring the aiming post into the field of vision.

c. Inspection and adjustment.

(1) **TELESCOPE MOUNT M18A1.**

(a) *Equipment.* For adjustment, a screwdriver, adjustable wrench, and the gunner's quadrant are required.

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RA PD 92610

Figure 138 — Panoramic Telescope M12

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(b) *General conditions.* Note the general appearance of the mount, the condition of the paint, loose or missing parts, and the condition of the locating surfaces. If any condition adversely affects the functioning of the mount, notify ordnance maintenance personnel.

(c) *Level vials.*

1. Check the security of the mounting of the level vial tube in the level bracket and the level bracket on the mount. If vials are broken or covers missing, notify ordnance personnel to replace.

2. To check the adjustment of the levels, remove the telescope from the mount and place the gunner's quadrant (set for zero elevation with the correction, if any, applied) on the top surface of the telescope socket parallel to the axis of the bore, and center the quadrant bubble with the longitudinal-leveling knob. A machined steel plate or a piece of plate glass placed on the top surface of the telescope socket will provide a surface for seating the gunner's quadrant. Note the position of the bubble in the longitudinal-level vial. The bubble must be centered within the allowable tolerance of one graduation. If adjustment of the level vial is necessary, notify ordnance maintenance personnel. Now shift the gunner's quadrant on the top surface of the telescope socket parallel to the axis of the gun trunnions. Center the quadrant bubble with the cross-leveling knob. The bubble must be centered within the allowable tolerance of one graduation. If adjustment of the level vial tube is necessary, notify ordnance personnel.

(d) *Worm gear backlash.* The worm gear of the longitudinal- and cross-leveling mechanisms should be inspected periodically for backlash. Operate the worms through their entire range. The effects of small amounts of backlash may be eliminated by habitually making the last movement always in the same direction. If an appreciable degree of backlash exists, adjustment should be made without delay by ordnance personnel.

(e) *Seating of panoramic telescope.* Apply a slight twisting motion to the telescope to determine if there is any play in its seat (tangent adjusting screws too loose). If play exists, tighten the tangent adjusting screws (fig. 141) and check the alinement as described below.

(2) **PANORAMIC TELESCOPE M12.**

(a) *Equipment.* For adjustments, a screwdriver, adjustable wrench, a bore sight, and a testing target are required.

(b) *General conditions.* Note the condition of paint; bent, broken, or missing parts; legibility of scales and indexes; condition of locating surfaces. If any of these conditions adversely affect the functioning of the telescope, notify ordnance personnel.

(c) *Exposed mechanical parts.* Check for smoothness of the operation of knobs, missing or damaged parts, and loose or missing

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screws. Tighten loose parts, and if any of the other conditions adversely affect the functioning of the telescope, notify ordnance personnel.

(d) *Azimuth mechanism.* Operate the azimuth worm through its entire range, noting if there is any backlash or binding. Operate the worm release lever and note if the spring holds the worm in mesh as the worm knob is turned. If backlash in the worm exists, measure the amount of backlash in the following manner:

1. Zero all scales.
2. Set the cross hairs on a definite target (edge of building, etc.).
3. Turn the azimuth knob 1 mil while sighting through telescope.
4. If cross hair does not move from target, backlash exists and should be removed by ordnance maintenance personnel.
5. Read the micrometer scale. The difference in reading is the amount of backlash.
6. Repeat the above operation in the opposite direction.
7. If the amount of backlash is $1\frac{1}{2}$ mils or more, it should be removed by ordnance personnel.

(e) *Elevating mechanism.*

1. Operate the elevating worm knob through its entire range, noting if there is any backlash or binding. The knob should rotate three turns above and below center before being stopped.

2. To check the coarse and fine indexes to see that they register zero simultaneously when the line of sighting is parallel to the bore of the gun, level the gun tube and bore sight the gun on a testing target. Turn the elevating knob on the telescope until the horizontal reticle line coincides with the horizontal line on the target. The coarse and fine indexes should both register zero. If the micrometer index does not register zero, loosen the screws in the end of the knob and, holding the knob, slip the elevation micrometer until the zero graduation lines up with the index; then tighten the screws, being careful not to disturb the setting. If the coarse index does not register zero, notify ordnance personnel to make necessary adjustments.

(f) *Optical system.* Carefully level the instrument, and then sight the telescope on a plumb line. Note if the vertical cross line of the reticle is parallel to the plumb line. Check the eyepiece assembly for looseness, and note the condition of the eyeshield. With the eyepiece pointed toward the sky, look through the objective end of the telescope, and note if there is any dirt or fungus growth inside the optical system, or frost patterns on the lenses. If any of these conditions exist, notify ordnance personnel to correct them.

(g) *Parallax.* Focus the telescope on a distant sharply-defined object, and aline the vertical cross hair of the reticle. Move the eye from side to side while observing. If the vertical cross hair appears

Part Four — Auxiliary Equipment

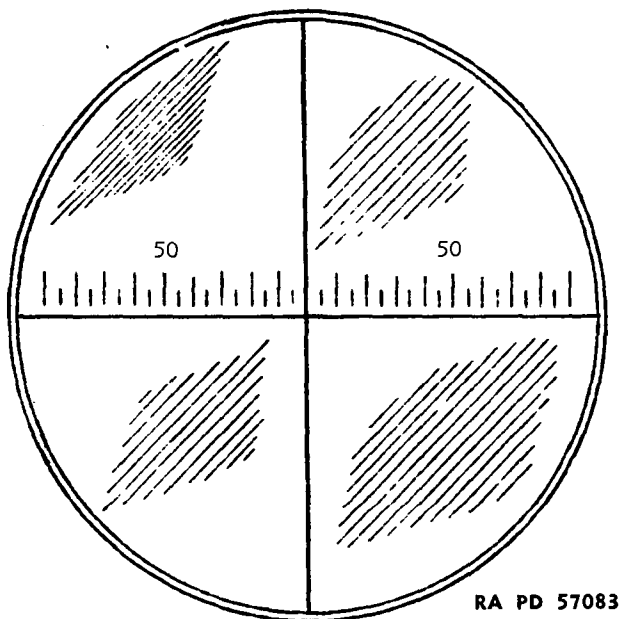


Figure 139 — Reticle Pattern for Panoramic Telescope M12

to move with respect to the target, parallax is present. Notify ordnance maintenance personnel to remove parallax.

(h) *Instrument lights.* Check clamps, cables, and sockets for looseness and short circuit. Remove battery holder cap and examine for corrosion, broken, or missing parts. Check for sufficient illumination of scales, level vials, and reticle. The using arm personnel may tighten loose parts and replace batteries and lamps. Notify ordnance personnel for other repairs.

d. Care and preservation.

(1) Stops are provided to limit the longitudinal- and cross-leveling motions, and no attempt should be made to force the mechanisms beyond these limits. Avoid rough handling which might disturb the adjustment of the telescope and mount.

(2) Wipe off all lubricant that seeps from the moving parts to prevent accumulation of dust and grit.

101. QUADRANT MOUNT M1.

a. *Description.* The quadrant mount M1 (fig. 142) is used in conjunction with a gunner's quadrant for laying the gun in elevation. It is attached to the right cradle trunnion of the carriage. Any motion of the gun in elevation causes the mount to rotate a like amount about the trunnion axis. A cross-level vial and cross-leveling mecha-

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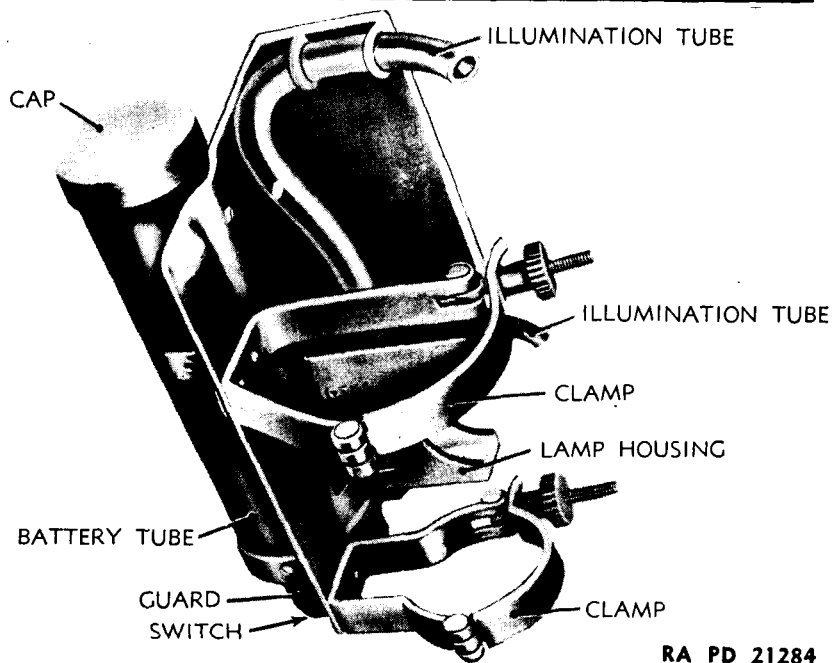


Figure 140 — Instrument Light M19

nism are used to keep the mount cross-leveled during operation of the instrument. The cross-level vial and gunner's quadrant are illuminated for night operation with the instrument light M12. The instrument light M12 also includes a hand light for illuminating the gunner's quadrant and for general use around the mount. The instrument light is attached to the mount as shown in figure 142, by slipping the bracket over the cross level and the lug adjacent to the level on the mount. It is secured by tightening the thumbscrew in the end of the bracket against the level housing. A standard flashlight battery, type BA-30, supplies power for the lamps at 1.5 volts.

b. Operation. To operate the quadrant mount M1, turn the cross-level knob until the bubble in the cross-level vial is centered. Set the gunner's quadrant to the required angle of elevation and, holding it in position on the level shoes, elevate the gun until the bubble in the level vial of the gunner's quadrant is centered. Remove the gunner's quadrant from the mount before firing the gun.

c. Adjustments. Adjustment of the quadrant mount by the using arm personnel is not permitted. Notify ordnance personnel when adjustments or repairs are required.

d. Care and preservation.

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(1) The motion of the cross-leveling mechanism is limited by stops in the segment, and no attempt should be made to force the mechanism beyond its limits. Care should be exercised to avoid bumping the segment or knob.

(2) Daily wipe clean and apply a film of oil to the shoes when the quadrant mount is not in use. Wipe off excess lubricant to prevent accumulation of dust and grit.

(3) Remove the flashlight battery when the instrument light is not to be used for long periods, to prevent corrosion of the tube.

102. BORESIGHTING PROCEDURE.

a. General.

(1) The purpose of the boresighting operation is to test the alinement of the sighting equipment for parallelism with the bore of the gun, and to provide a basis for adjustment if the sighting equipment is found to be out of alinement. The operation is sometimes referred to as "zeroing," "targeting," or "adjustment of sights."

(2) Careful adjustment of the sighting equipment, before going into action, will greatly reduce the number of rounds wasted, and the time consumed before getting a hit.

(3) Either of two kinds of targets may be used in the adjustment procedure for boresighting; a well-defined fixed object (aiming point) at least 1,500 yards distant from the gun or a testing target, 80 to 120 feet distant.

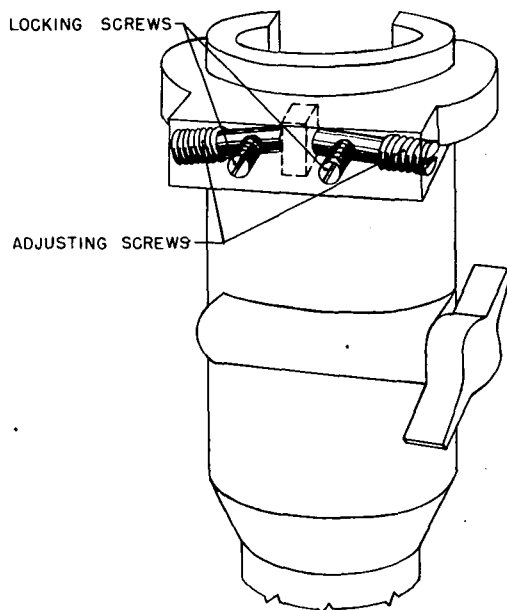
(4) A bore sight is furnished with the gun.

b. Equipment for boresighting.

(1) **BORE SIGHT.** The line which passes through the center of the gun bore is chosen as the reference line from which all adjustments are made. The bore sight is used to determine this line. The bore sight (fig. 143) consists of a breech bore sight and muzzle bore sight, designed in the shape of disks for insertion in the corresponding parts of the gun. The four outer holes in each sight provide finger holds for insertion and extraction of the disks. The small, centrally located hole (peep sight) in the breech bore sight, is used for boresighting. The larger hole above the peep sight is used for rough approximate aiming. The irregular shaped, centrally located opening in the muzzle bore sight is designed to obtain sufficient view of the target for centering in the opening at the center of the straightedge. If the issue bore sight is not available, the removal of the percussion mechanism from the breechblock and the use of the firing pin hole as a peep sight may be substituted for the breech sight, and crossed strings may be attached across the muzzle by securing them with a string, tape, or web belt as a substitute for the muzzle sights.

(2) **TESTING TARGET.** If a testing target is not available, construct one on cardboard or some other suitable material in accordance

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RA PD 4283

Figure 141 — Telescope Tangent Adjusting Screws

with the design shown in figure 144. To construct a testing target, first measure the horizontal and vertical distances (nearest $\frac{1}{16}$ inch) that the optical center of the panoramic telescope is offset from the axis of the gun bore, and record the measurement as *right* or *left* and *up* or *down*. Then, draw horizontal and vertical intersecting lines on the cardboard to represent the gun bore, and mark the intersection, "BORE AIMING POINT." Now, accurately lay off the recorded measured horizontal and vertical distances for the telescope, being careful to place the aiming point on the correct side of the "BORE AIMING POINT." Mark this aiming point "PANORAMIC TELESCOPE M12." Label the top of the testing target "TOP" to avoid inverting the testing target accidentally when boresighting. Protect the testing target against dampness to avoid shrinkage.

(3) **GUNNER'S QUADRANT.** The gunner's quadrant is used to level the gun (axis of bore and axis of trunnions) while performing the boresighting.

c. Preliminary settings.

(1) It is important that the line through the cradle trunnions, crosswise to the gun bore, be fairly level when boresighting. Check the leveling with the gunner's quadrant on the flat top surface of either trunnion cap. The trunnions will generally be level when the carriage is on level ground.

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(2) Alinement of the panoramic telescope can be performed by use of either a testing target, or by use of a sharply-defined distant aiming point. The use of a testing target establishes the telescope line of sighting parallel to the gun bore. The use of a distant aiming point results in a line of sighting which converges toward the line of the gun bore. The more distant the aiming point, the more nearly parallel will be the line of sighting, and the axis of the bore. If the aiming point is chosen about 1,500 yards or more distant, the line of sighting and the axis of the bore will be near enough to parallel for all practical purposes. Choice of method will depend on time and facilities available. The aiming point may be used whenever the testing target is not available, but its use is necessarily restricted to open terrain and clear weather. The testing target can be used at night, and requires only an open space of 120 feet or less.

(3) When using the testing target, line it up with the gun in the following manner:

(a) First, level the gun with the elevating handwheels, and check the leveling with the gunner's quadrant placed on the leveling plates on the breech ring.

(b) The testing target may be either hung from a support or mounted on a post. Place the testing target 80 to 120 feet in front of the gun. The more distant the target, the less will be the error produced by inaccuracies in constructing the target. Move the testing target until the bore aiming point is seen through the bore sights, centered in the gun bore.

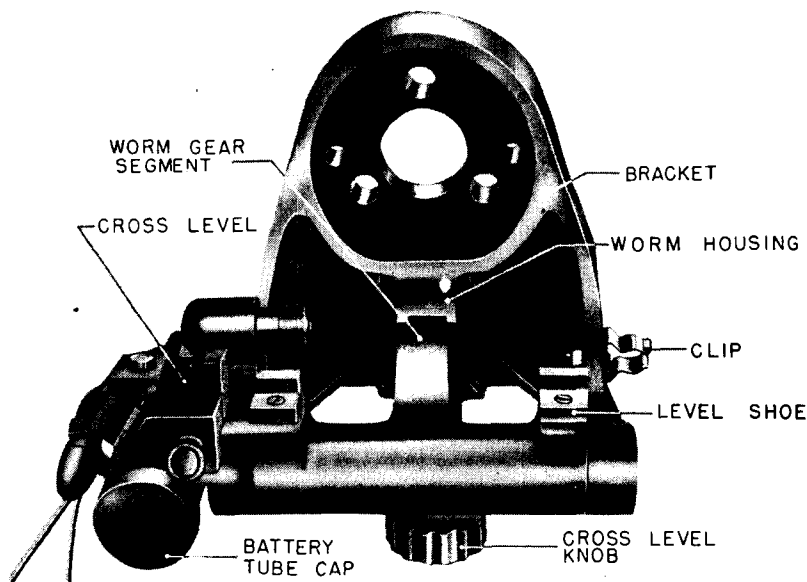
(c) While centering, keep the face of the testing target square with the bore. The horizontal edge of the target should be level. However, if the gun trunnions are slightly out of level, the horizontal edge of the target should be out of level by the same amount, and in the same direction. This measurement is avoided by leveling the gun trunnions at the start. Check the verticality of the target with a plumb line. Once the alinement has been obtained, do not shift the gun or testing target until the borsighting has been completed.

d. Verification of line of sighting of panoramic telescope M12.

(1) **FOR ELEVATION.** With the elevation knob, place the zero range line (optical center) of the reticle on the horizontal line of the testing target or on the terrain aiming post. The elevation micrometer and the elevation scale should both indicate zero. If the elevation scale does not indicate zero, notify ordnance personnel to make the adjustment. If the elevation micrometer does not indicate zero, loosen the screws in the end of the elevating knob and, holding the knob, slip the micrometer until the zero graduation coincides with the index. Then tighten the screws and recheck.

(2) **FOR DIRECTION.** With the azimuth worm knob, place the vertical line (optical center) of the reticle on the vertical line of the

Part Four — Auxiliary Equipment



RA PD 6825

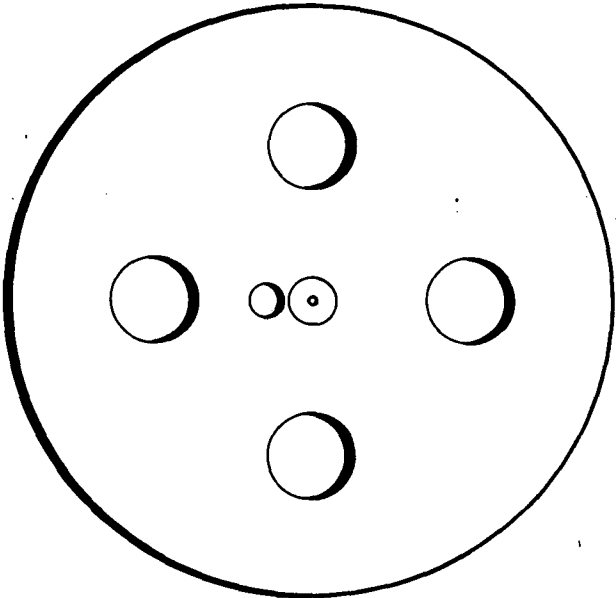
Figure 142 — Quadrant Mount M1 With Instrument Light M12

testing target or on the terrain aiming point. The azimuth scale and micrometer should both register zero. If either the azimuth scale or the micrometer, or both, do not register zero, they may be brought to zero by loosening appropriate screws, slipping the scales into coincidence and retightening.

e. Verification of line of sighting of panoramic telescope M5A5. The adjustment for elevation is performed in the same manner as for the panoramic telescope M12 described above. The adjustment for direction is performed in a different manner than for the panoramic telescope M12, as the azimuth scale on the panoramic telescope M5A5 is not adjustable. If the azimuth scale is so far removed from the 0 graduation that it may be closer to either the 100-mil or 6,300-mil graduation, proceed as follows:

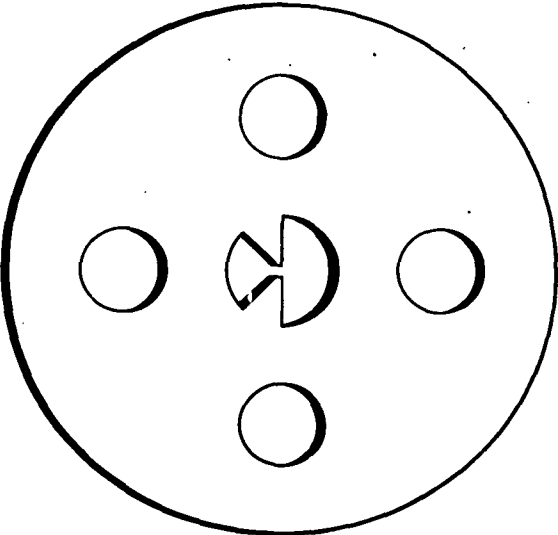
- (1) Move the azimuth scale index into coincidence with the zero graduation of the azimuth scale by rotating the azimuth worm knob. The line of sighting is now removed from the testing target or terrain aiming point. If, at the zero setting of the azimuth scale, the azimuth micrometer index does not coincide with the fixed index (zero setting), they should be brought into coincidence as described below.

- (2) If the movable azimuth micrometer index does not coincide with the fixed index (zero setting), loosen the screw in the movable index and, while holding the azimuth worm knob, slip the micrometer



SIGHT, BREECH BORE

RA FSD 1737



SIGHT, MUZZLE BORE

Figure 143 — Bore Sight

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index until coincidence is secured. Tighten the screw, and check to see that the azimuth scale index has not moved off the zero graduation of the azimuth scale.

(3) To bring the line of sighting back to the testing target or the terrain aiming point, the telescope must be rotated in the telescope socket. This is accomplished by loosening the tangent screw lock screws, and rotating the telescope by backing off the tangent screw in whichever direction the line of sighting is to be moved, and tightening the opposite tangent screw until the vertical line (optical center) coincides with the vertical line on the testing target or on the terrain aiming point. Tighten the other tangent screw until a snug fit without binding is obtained, and then tighten the lock screws.

103. CARE AND PRESERVATION OF SIGHTING AND FIRE CONTROL EQUIPMENT.

a. General.

(1) These general instructions supplement instructions pertaining to individual instruments included in the preceding paragraphs.

(2) Fire control and sighting instruments are, in general, rugged and suited to the purposes for which they have been designed. They will not, however, stand rough handling or abuse. Inaccuracy or malfunctioning will result from such mistreatment.

(3) Disassembly and assembly by the using arms are permitted only to the extent authorized in the paragraphs dealing with the individual instruments. Unnecessary turning of screws or other parts, not incident to the use of the instrument, is expressly forbidden.

(4) Keep the instruments as dry as possible. Do not put an instrument in its carrying case when wet.

(5) When not in use, keep the instruments in the carrying cases provided, or in the condition indicated for traveling.

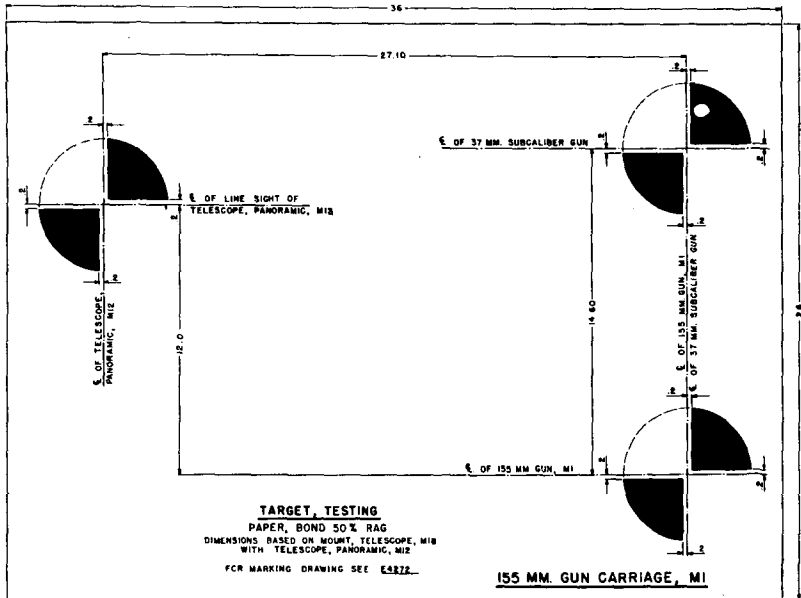
(6) Any instruments which indicate incorrectly, or fail to function properly after the authorized tests and adjustments have been made, are to be turned in for repair by ordnance personnel. Adjustments, other than those expressly authorized in the paragraphs dealing with the individual instruments, are not to be performed by the using arms.

(7) Many worm drives have throw-out mechanisms to permit rapid motion through large angles. When using these mechanisms, it is essential that the throw-out lever be fully depressed to prevent injury to the worm and gear teeth.

b. Optical parts.

(1) To obtain satisfactory vision, it is necessary that the exposed surfaces of the lenses and other parts be kept clean and dry. Corrosion and etching of the surface of the glass, which greatly interfere

Part Four — Auxiliary Equipment



RA PD 102551

Figure 144 — Testing Target for 155-mm Gun Carriage M1

with the good optical qualities of the instrument, can be prevented, or greatly retarded, by keeping the glass clean and dry.

(2) Under no condition will polishing liquids, pastes, or abrasives be used for polishing lenses and windows.

(3) For wiping optical parts, use only clean lens tissue paper. Use of cleaning cloths in the field is not permitted. To remove dust, brush the glass lightly with a clean camel's-hair artist brush, and rap the brush against a hard body to knock out the small particles of dust that cling to the hairs. Repeat this operation until all dust is removed. With some instruments, an additional brush with coarse bristles is provided for cleaning mechanical parts. It is essential that each brush be used only for the purpose intended.

(4) Exercise particular care to keep optical parts free from oil and grease. Do not wipe lenses or windows with the fingers. To remove oil or grease from optical surfaces, apply lens cleaning liquid soap or ethyl alcohol with a tuft of lens tissue and rub gently with clean lens paper. Rinse with clean water after application of these liquids. If these liquids are not available, breathe heavily on the glass and wipe off with clean lens paper; repeat this operation several times until the glass is clean.

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(5) Moisture, due to condensation, may collect on the optical parts of the instrument when the temperature of the parts is lower than that of the surrounding air. This moisture, if not excessive, can be removed by placing the instrument in a warm place. Heat from strongly concentrated sources should not be applied directly, as it may cause unequal expansion of parts, thereby resulting in breakage of optical parts or inaccuracies in observation.

(6) Optical surfaces should be cleaned in cold weather by using lens tissue paper moistened with a few drops of ethyl alcohol. If ethyl alcohol is not available, a dry lens tissue paper is satisfactory. Do not apply alcohol directly to the optical surfaces.

(7) LUBRICATION. All external unpainted metal surfaces and bearing surfaces will be wiped clean and a thin film of preservative lubricating oil (special) applied daily. In areas of high humidity or extreme moisture and atmospheric temperatures in excess of +32° F, preservative lubricating oil (medium) will be used. Apply sparingly and wipe off excess.

c. **Batteries.** Batteries used in instrument lights should habitually be removed whenever the instrument light is not in use. Chemical reaction set up in exhausted batteries will damage the battery tube. To remove batteries, remove the cap on the battery tube. The cap is secured by bayonet pins, and is easily removed by pressing the cap downward, and turning slightly until free.

Section XXIX**SUBCALIBER EQUIPMENT****104. GENERAL.**

a. **Purpose.** Subcaliber equipment provides a means for more extensive training in laying and firing, through the use of small caliber ammunition, than would be permissible with standard 155-mm ammunition. It prevents wear on the regular piece during practice, and is less costly. Although the handling, loading, and range obtained differ from those of the regular piece, the results obtained in elevating, traversing, sighting, and similar operations are adequate for instructional purposes.

b. **Description.** Subcaliber equipment consists of the 37-mm gun M1916 complete with recoil mechanism, the 37-mm subcaliber mount M10, and organizational spare parts and accessories. The gun and subcaliber mount are mounted on the gun tube of the primary weapon (fig. 145).

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105. BREECHBLOCK AND BREECH MECHANISM (fig. 146).**a. Description.**

(1) The breechblock is the Nordenfeld or eccentric type which screws into the breech ring and rotates through an angle of 156 degrees about its axis. The axis of the breech recess is below the axis of the bore. The breechblock is operated by the breechblock lever which, when moved to the left, causes the breechblock to rotate, thus carrying the eccentric opening in the breechblock to a position in line with the bore. This lever also indirectly operates the extractor, which extracts and ejects the cartridge case. When the lever is moved to the right, the breechblock closes, placing the firing pin in line with the percussion cap in the base of the cartridge case, and at the same time releases the safety bolt.

(2) The safety bolt is the device which prevents firing of the gun when the breechblock is not fully closed.

(3) The firing mechanism, which is housed in the breechblock, consists of the firing pin, firing pin spring, rocker, rocker pin, rocker pin latch, and rocker plunger. When the trigger crank lever is pressed down, the firing pin strikes the percussion cap, thus firing the gun.

b. Operation.

(1) To cock, place the palm of the hand against the cocking handle of the striker and push it forward until it latches. After the first shot the mechanism is automatically cocked. If the round is not to be fired, open the breechblock and remove the round from the gun. Do not uncock the piece while it is loaded, as the mechanism must be cocked before the breechblock can be opened.

(2) To open the breech, rotate the breechblock lever to the left as far as it will go. If the firing mechanism has been tripped, however, it will be necessary to first cock the mechanism before the breech can be opened.

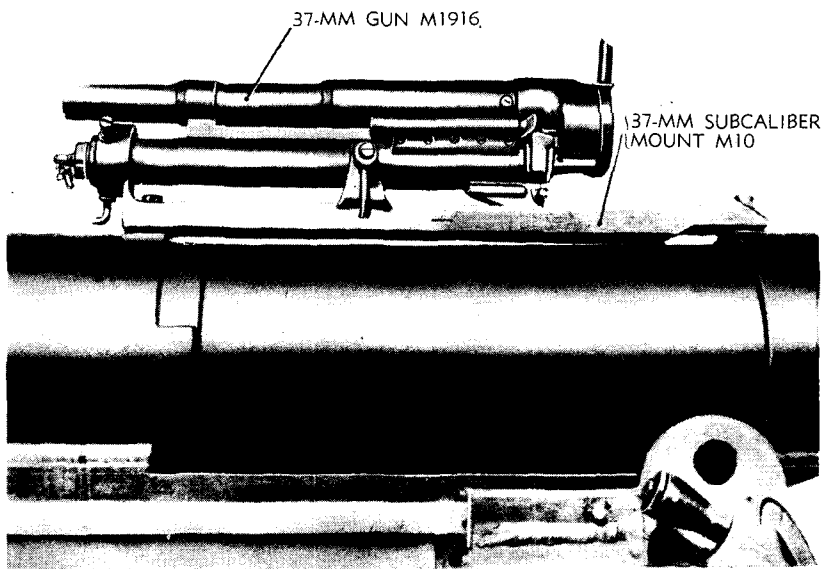
(3) To load, insert the round, pushing the cartridge case in as far as is allowed by the extractor.

(4) To close the breech, grasp the breechblock lever and rotate it to the right as far as it will go. During the first part of the movement, a ramp on the front of the breechblock pushes the cartridge case in flush with the face of the breechblock. The cartridge case is then pushed home by the forward movement of the breechblock in the breech ring threads.

c. Disassembly and assembly.

(1) To dismount the breechblock, cock the piece with the left hand by means of the cocking handle on the striker. Remove the breechblock lever with the right hand by grasping the handle with the fingers and pressing the breechblock lever release pin cap with

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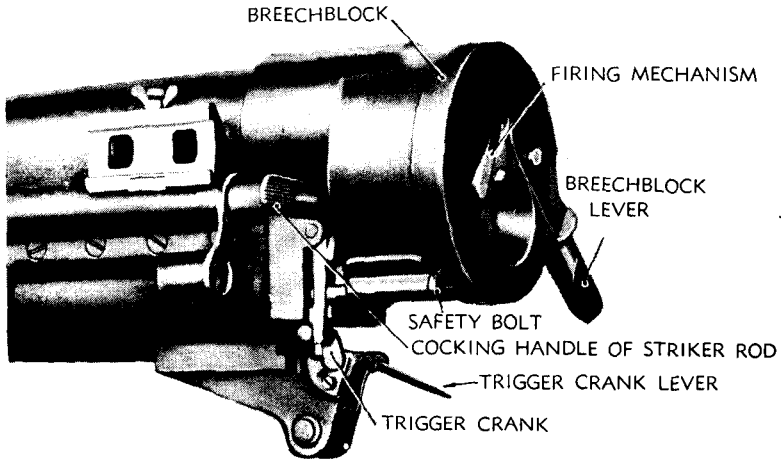
RA PD 60803

Figure 145 — Subcaliber Equipment Mounted on 155-mm Gun

the thumb. Take out the extractor pin by pressing the extractor pin latch toward the breech with the left forefinger, and pulling it out to the right with the right hand. The extractor will drop down until its heel clears the extractor cam. Then unscrew the breechblock to the left, grasping it firmly in the right hand and supporting it with the left hand.

(2) To replace the breechblock, first see that the breech recess, extractor, and threads of the breechblock are thoroughly cleaned and lightly oiled. Then set the extractor in its seat, but do not insert the extractor pin. Next, cock the mechanism, screw the breechblock home, and set the breechblock lever in place. Raise the extractor by pushing upward on its heel from under the block, and insert the extractor pin from the right until the extractor pin latch springs out and secures the pin. Uncock the mechanism by pressing down on the trigger lever with the right thumb, while applying pressure against the cocking handle with the left hand so as to prevent too fast a movement of the striker. **NOTE: Do not attempt to screw the breechblock in or out without first removing the extractor pin.**

(3) To dismount the extractor, dismount the breechblock as directed in step (1), above. Withdraw the extractor by inserting the left forefinger in the mortise in the base of the breech ring, slightly raising the extractor and grasping it with thumb and finger of the right hand.

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RA PD 71450

**Figure 146 — Breechblock and Breech Mechanism of
37-mm Gun M1916 — Left Rear View**

(4) To assemble the extractor, see step (2), above.

(5) To dismount the firing mechanism, the gun should be cocked or the breechblock dismounted. The rocker pin is retained in its seat by the free end of the spring entering the grooves in the outer end of the rocker pin. This spring may become stuck with paint, and should be freed by scraping the paint around the edge before attempting to remove the rocker pin. The head of the rocker pin projects at one side of the port. Place a small bronze drift against the projecting head and, with light taps, drive the pin into the port. The rocker is then free and, when removed, exposes the firing pin which will be pushed out by its spring and the rocker plunger, all of which may then be taken out.

(6) To assemble the firing mechanism, first clean and lubricate all parts. Then insert the rocker plunger, firing pin spring, and firing pin. Hold the rocker pin down in its seat with the thumb until the rocker pin can be started through. Push the pin home and see that the rocker pin latch springs into the groove.

(7) To remove the piston crosshead key, disengage the striker, press up on the piston crosshead key latch, and push out to the left.

(8) To assemble the piston crosshead key, first examine and lubricate the parts. Push the key in place with the trigger crank lying in front of the long arm of sear. See that the safety bolt properly engages the descending arm of the sear before the piston crosshead key is

Part Four — Auxiliary Equipment

pushed fully home. Failure to have the safety bolt in the proper position will prevent the crosshead key from being fully pushed in, and an attempt to force it will cause damage to the sear.

(9) To disassemble the striker mechanism, first remove the piston crosshead key. Draw the gun back about 8 inches and push the striker to its extreme forward position to loosen the striker rod nut set screw and unscrew the striker rod nut. Allow the spring to expand slowly and push the striker rod out. Clean all parts. Free height of the striker spring should be 6.81 inches. If it is as much as 0.5 inch less than this, replace it with a new spring.

(10) To assemble the striker mechanism, first thoroughly oil the striker spring and striker rod with engine oil (SAE 30 above 32° F; SAE 10 from 0° F to 32° F). Place the striker spring over the rod and insert both in the striker housing. Push the striker to the extreme forward position and turn the nut until the front edge of the nut is about flush with the front end of the striker rod, taking care that the striker rod nut set screw comes opposite its keyway in the striker housing. The stroke of the striker rod may be lengthened by unscrewing the striker rod nut a few turns. The set screw must not be omitted, and must be set so that it does not strike the bottom of the keyway.

106. RECOIL MECHANISM.

a. Description.

(1) The recoil mechanism is located in the cradle underneath the gun, and the gun slides over it during recoil and counterrecoil. It consists of the recoil mechanism, counterrecoil mechanism, and counterrecoil buffer.

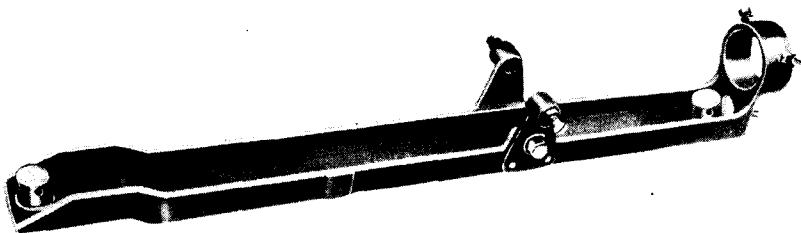
(2) The recoil mechanism is used for the purpose of controlling the force created by firing and to check movement of the gun in a gradual manner. The counterrecoil mechanism is used for the purpose of returning the gun into battery in order that it may be fired again. The counterrecoil buffer is used for the purpose of slowing down and stopping the counterrecoil action without injury to the system.

107. 37-MM GUN.

a. **Disassembly.** Release the striker and take out the piston crosshead key by pressing up its latch and pushing it out to the left. Carefully draw the gun back off the cradle of the recoil mechanism by grasping the muzzle with one hand, and the breech with the other.

b. **Assembly.** See that the gun slides and the piston crosshead are thoroughly cleaned and lubricated. Insert the gun from rear, carefully maintaining alinement to avoid jamming the gun slides. Replace the piston crosshead key.

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RA PD 60804

Figure 147 — 37-mm Subcaliber Mount M10**108. SUBCALIBER MOUNT M10 (fig. 147).**

a. **Description.** The subcaliber mount consists of a cradle mounting bracket to which is affixed the right cradle trunnion bearing bracket. The left cradle trunnion bearing is cast as an integral part of the cradle mounting bracket. Both trunnion bearings are equipped with cap screws and jam nuts which not only retain the gun cradle in position but also provide a means of lateral adjustment. The collar at the front end of the cradle mounting bracket houses three screws and jam nuts, which retain the front end of the recoil cylinder and also provide a means of vertical adjustment.

109. MOUNTING SUBCALIBER EQUIPMENT.

a. To mount the subcaliber mount, align the holes on the bottom of the cradle mounting bracket with those on the front two loops of the 155-mm gun tube and secure the bracket with the two mount clamping bolts provided (fig. 145).

b. To mount the subcaliber gun, loosen the adjusting screws in the front collar of the mount. Remove the cradle trunnion bracket from the right side of the cradle mounting bracket by removing the cap screw and washer which retains it in position. Lift the 37-mm gun with recoil mechanism to the top of the 155-mm gun and insert the front end of the recoil cylinder through the front collar of the mount, meanwhile placing the trunnion of the recoil mechanism in the trunnion bearing on the left side of the cradle mounting bracket. Assemble the cradle trunnion bracket to the cradle mounting bracket, and secure it with the cap screw and washer. Tighten cap screws in the trunnion bearings and those in the front collar just sufficient to retain the 37-mm gun in position.

c. **Counterbalancing the 155-mm gun.** With the 37-mm gun recoil mechanism and the subcaliber mount in place, the increased force required to elevate the 155-mm gun without counterbalance is negligible; therefore, no counterbalancing weight is required.

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110. DISMOUNTING SUBCALIBER EQUIPMENT. Dismounting is accomplished by reversing the procedure required for mounting the subcaliber equipment.

111. CARE AND PRESERVATION.

a. The 37-mm gun should be kept in perfect condition and thoroughly cleaned and oiled. Only such cleaning and preserving materials as are issued for this purpose will be used. It is especially important that all parts of the gun be kept free from rust. The following instructions for cleaning these parts will be strictly observed:

(1) The bore and chamber of the subcaliber gun require particular attention and will be thoroughly cleaned immediately after firing, and on 3 consecutive days thereafter, by swabbing until clean with a solution of one-half pound of soda-ash per gallon of warm water; rinse with clear water, then dry thoroughly, using burlap or cloths; inspect, then oil. Daily, when the gun is not being fired, wipe clean and renew the oil film.

(2) The breechblock and the firing mechanism will be thoroughly cleaned with dry-cleaning solvent, wiped dry, inspected, and oiled. All parts, recesses, and breechblock threads will be lightly oiled.

(3) The trigger mechanism will be kept free from dust and foreign-matter and, after use, all parts will be carefully wiped dry and a drop of oil put on the striker bearings, trigger bearings, and safety bolt.

(4) The gun slides will be cleaned and freely oiled.

b. Recoil mechanism adjustment by the using arm is prohibited. All maladjustments should be reported to ordnance personnel. Refilling of the mechanism, however, is permitted. An empty recoil mechanism requires $2\frac{3}{4}$ pints of oil, or 21 oil gun fills. Only recoil oil (special) is used for this purpose. The filling procedure is as follows:

(1) Raise rear end of recoil mechanism higher than front end.

(2) Fill oil gun.

(a) Unscrew nozzle of oil gun.

(b) Pull the plunger back.

(c) Fill oil gun with recoil oil.

(d) Replace the nozzle.

(e) Push the plunger up gently to force out the air.

(3) Remove the filling plug in front of the cradle.

(4) Screw the oil gun into the filling hole.

(5) Remove the drain plug in the right rear side of the cradle.

(6) Push the plunger of the oil gun in slowly, at the same time watching for the escape of oil from the drain hole. When oil runs out free of air bubbles, the recoil mechanism is full.

(7) Remove the oil gun. Before replacing the filling and drain plugs, let about two teaspoonfuls of oil escape, then screw the two plugs in tightly. This is necessary as the expansion of oil during prolonged fire may interfere with the complete return of the gun to battery.

Part Four — Auxiliary Equipment

c. The 37-mm subcaliber mount requires repairs that are minor in nature and involve only the removal of burs when necessary, and the replacement of some parts. When the subcaliber mount is disassembled, all screws, nuts, and washers should be assembled in their proper places.

d. Proper lubrication of the subcaliber equipment is necessary if the mechanism is to function smoothly and give long service. The 37-mm gun materiel has very few oilholes or fittings, yet it requires oiling of certain bearings. The following guide indicates where lubrication is necessary, the kind of lubricant, amount required, frequency, and method of application required in active service.

LUBRICATION GUIDE
37-MILLIMETER GUN MATERIEL M1916

Part	Method	Kind	Remarks
Bore	Slush	OIL, engine. (below 32° F), SAE 10 (above 32° F), SAE 30	*Daily and after firing, clean, dry, and oil bore.
Breechblock	Apply oil to threads	OIL, engine (below 32° F), SAE 10 (above 32° F), SAE 30	*Daily. Unscrew breechblock.
Firing pin	Drops at contact surfaces	OIL, engine (below 32° F), SAE 10 (above 32° F), SAE 30	*Daily. While breechblock is dismantled.
Extractor and extractor pin	Drops at contact surfaces	OIL, engine (below 32° F), SAE 10 (above 32° F), SAE 30	*Daily. While breechblock is dismantled.
Safety bolt	Drops at ends of bracket	OIL, engine, (below 32° F) SAE 10 (above 32° F), SAE 30	*Daily. While breechblock is dismantled.
Sear	Drops at bearing surfaces	OIL, engine (below 32° F), SAE 10 (above 32° F), SAE 30	*Daily. While breechblock is dismantled.
Striker spring	Slush	OIL, engine (below 32° F), SAE 10 (above 32° F), SAE 30	At assembly.
Piston cross-head key	Drops at contact surfaces	OIL, engine (below 32° F), SAE 10 (above 32° F), SAE 30	At assembly.
Gun slides	Cover bearing surfaces	OIL, engine (below 32° F), SAE 10 (above 32° F), SAE 30	Dismount gun.
Trigger crank	One drop at each end of bearing	OIL, engine (below 32° F), SAE 10 (above 32° F), SAE 30	Once a week.

*At low temperatures, clean with dry-cleaning solvent and lubricate with preservative lubricating oil (special).

Part Four — Auxiliary Equipment

112. PREVENTIVE MAINTENANCE SCHEDULES FOR THE 37-MM GUN MATERIEL. The following table contains instructions designed to insure proper functioning of the 37-mm gun materiel at all times. These instructions must be scrupulously observed.

ITEM	PREVENTIVE MAINTENANCE	INSTRUCTIONS
Before Firing		
Gun, recoil mechanism, and mount as a unit.	General inspection.	Note appearance of weapon. Check to see that spare parts set is complete, that mount is securely fastened to primary weapon, and that both weapons are properly boresighted (see par. 116). Try ejection with empty shell case.
Gun barrel.	Inspect, clean, and dry.	Wipe the bore dry with clean, dry bur-lap or wiping cloth. Examine the treads in the breech recess for burs and rough surfaces. The chamber and bore should be free from pits and rust. Remove the piston crosshead key and slide the gun back to insure that the jacket shoe and recoil ways are free from burs.
Piston cross-head key.	Inspect, clean, and lubricate.	If the sear, sear spring, or sear plunger becomes worn, entire key should be replaced.
Breechblock.	Inspect and check for proper functioning.	Rotate the breechblock from right to left and back several times, noting whether there is any stiffness or binding. Remove the breechblock from the breech ring (par. 105 c) and examine the threads on both for burs and rough surfaces. Inspect the firing pin hole in the face of the breechblock, depress the rocker plunger, and note how far the firing pin protrudes. With the rocker plunger fully depressed, the firing pin should protrude approximately $\frac{1}{8}$ inch. Remove the firing mechanism. Examine the parts for rust and burred surfaces. The free length of firing pin spring is $\frac{25}{32}$ inch. Test the tension of the breechblock lever latch spring. Replace all worn parts with new ones, or with parts that are declared usable by ordnance personnel.
Recoil mechanism.	Check for leaks and proper functioning.	Remove the gun from the recoil mechanism and examine the front and rear cradle caps for oil leaks, and for leaks at the piston rod packing washer. Check the quantity of oil in recoil mechanism. Perform a retraction test. A simple retraction test may be made by manually retracting the gun, blocking it with a piece of wood about 10 inches long, and then pulling out the block with a cord or wire. The gun should return to battery quickly, but without shock.

Part Four — Auxiliary Equipment

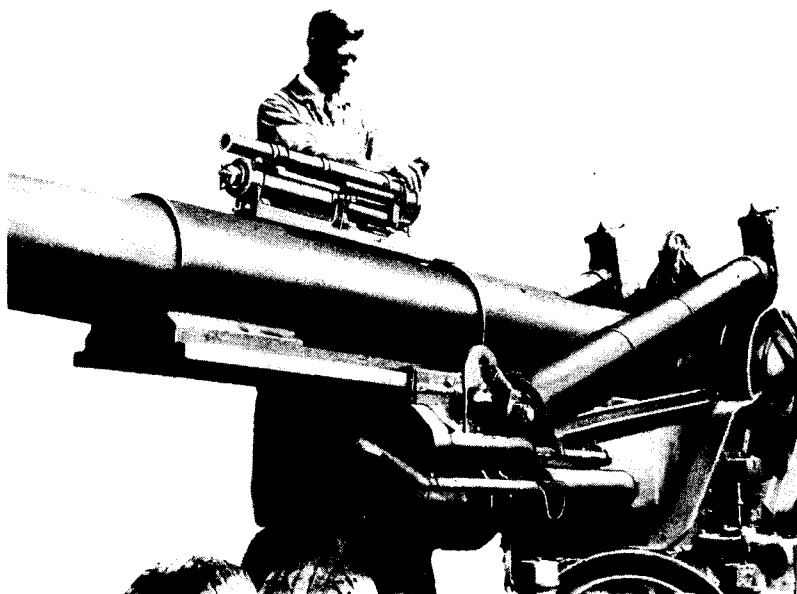
ITEM	PREVENTIVE MAINTENANCE	INSTRUCTIONS
Striker and trigger mechanisms.	Inspect and check for proper functioning.	Test the tension of the striker spring and sear plunger spring. Test the action of the trigger crank and trigger crank lever. The trigger crank plunger should have tension enough to hold the trigger crank in place. Examine the sear and sear notch for burs or worn surfaces.
During Firing Gun barrel.	Examine bore for powder fouling.	Clean with bore brush if necessary.
Recoil mechanism.	Check for proper functioning.	The length of recoil should be measured for the first few rounds and then at regular intervals.
After Firing Gun barrel.	Clean and lubricate.	See paragraph 111.
Breechblock, and striker and trigger mechanisms.	Clean and lubricate.	Disassemble, clean, and relubricate.
Recoil mechanism.	General inspection.	Examine for worn, loose, or broken parts.

113. MALFUNCTIONS AND CORRECTIONS.

a. The gun may, under certain conditions, either fail to return completely to battery, or may return too suddenly with a shock which will tend to damage the weapon. The firing mechanism may jam, there may be a defective cartridge, or a failure to eject an empty cartridge case properly, or the breech may not open.

(1) Incomplete return to battery is evident when the firing mechanism does not cock, or the cocking is not sufficient to fire the next round. This may be caused by weakened counterrecoil springs, scored or scratched jacket shoe guides, a dented recoil cylinder, or by an excess of oil in the recoil mechanism caused by the expansion of the oil from continued firing. In the latter case, a little oil may be let out of the recoil mechanism by unscrewing the drain plug located on the rear right side of the cradle. If it is thought that the condition of the guides is causing the difficulty, the gun should be dismounted and the guides examined for traces of scratches, fouling, etc. These may be remedied by use of crocus cloth followed by a thorough cleaning and oiling. Test the operation of the gun in the slides before replacing the piston cross-head key.

(2) Sudden return to battery, with a jarring impact, is caused by incomplete buffer action at the end of counterrecoil; that is, insufficient oil in the recoil mechanism. Ordinarily, addition of a little oil will remedy this condition. To do this, refill by removing the filling plug at the front of the cradle and inject sufficient oil by means of the oil gun.

Part Four — Auxiliary Equipment

RA PD 60805

**Figure 148 — Operation of Subcaliber Equipment at
Extreme Right Traverse**

(3) Trigger crank lever jamming, which prevents depression sufficient to operate the firing mechanism, can usually be attributed to incomplete closure of the breech, which causes the safety bolt to lock the sear. The cartridge case should be examined for damaged rim or other defects tending to prevent its insertion into the chamber. Another round may be tried. If the round is not the cause of the difficulty, examine the chamber for dirt, or fouling, and the trigger mechanism for broken or damaged parts and for foreign matter which may have become caught in the mechanism. Broken or damaged parts should be replaced.

(4) Failure to fire is caused by a defective primer, a weakened striker spring, a worn or broken firing pin, or dirt in the firing pin recess. If two percussions are frequently necessary to produce discharge, the striker spring has either become weakened and should be replaced, or it is so clogged with dirt and hardened grease that it cannot function properly. If no defect can be found in the firing mechanism and the round does not fire after two percussions, wait 30 seconds, and then replace it with another round, as the primer is defective.

(5) Defective extraction may occur when the cartridge case tends to stick in the chamber either because the chamber is burred or fouled with powder, or because the extractor is damaged or broken. A poor

Part Four — Auxiliary Equipment



RA PD 60806

**Figure 149 — Operation of Subcaliber Equipment at
Extreme Left Traverse**

cartridge case may stick in the chamber because of expansion, in which case the hand extractor should be used to complete extraction. Careful use of crocus cloth will correct sticking caused by burrs in the chamber. If the extractor is broken or damaged, it should be replaced.

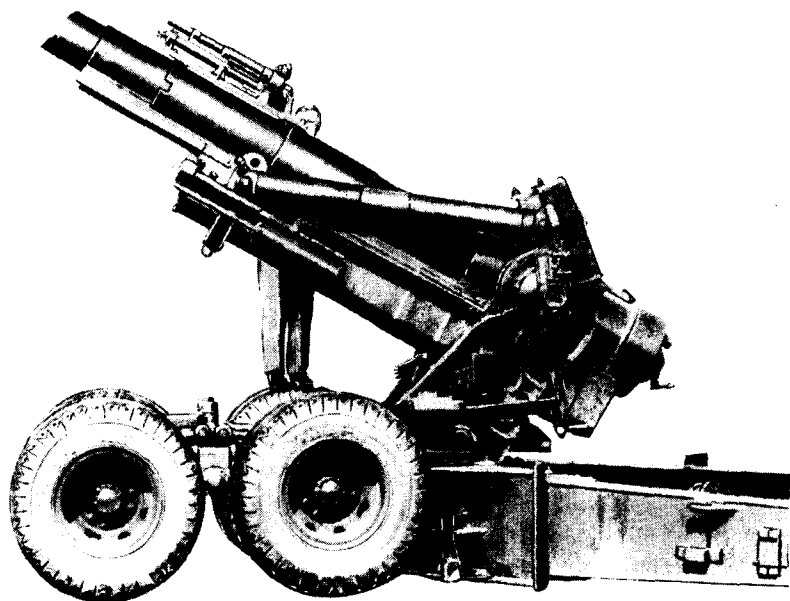
(6) Failure of the breech to open may be caused by the firing pin being stuck in the primer, or the gun may be uncocked. The former may be caused by a burred rocker, which can be corrected by careful use of crocus cloth, or a defective primer, which should be replaced by a new one. The gun may be uncocked because the cannoneer failed to release the trigger crank lever, because of a worn or broken sear, a defective sear plunger and spring, or a worn or broken shoulder on the striker rod.

114. PRECAUTIONS.

a. Firing.

(1) Before firing, check to be sure that the bore is clean and dry, the recoil mechanism is correctly filled, the mount is securely fastened to the primary weapon, and both weapons are properly boresighted. Also check to see that the spare parts set is complete, all moving parts are oiled, and that all parts are functioning properly. In addition, perform the retraction test.

Part Four — Auxiliary Equipment



RA PD 60807

**Figure 150 — Operation of Subcaliber Equipment
at 30-degree Elevation**

(2) During firing, should a misfire occur, recock, relay, and make two attempts to fire. If failure continues, wait 30 seconds before opening breech. Always release the trigger crank promptly.

(3) Immediately after firing, clean the piece thoroughly, examining the recoil mechanism for worn, loose, or broken parts.

b. Handling.

(1) No attempt should be made to repair or disassemble the recoil mechanism except by ordnance personnel. The using arm may only fill or drain it as necessity requires.

(2) Avoid working the trigger mechanism when there is no cartridge in the chamber. Do not attempt to force the trigger crank lever when the breech is not completely closed. The sear is locked by the safety bolt, on the left side of breech ring, and cannot move with the breech open.

(3) The breechblock should not be opened unless the firing mechanism is cocked.

(4) The walls of the recoil cylinder and of the striker housing, attached to the recoil mechanism, are relatively thin. Dropping the recoil mechanism, therefore, may dent them and cause internal interferences.

Part Four — Auxiliary Equipment

115. OPERATION.

a. The normal position for operating the subcaliber equipment is from the right side. Caution is required on the first round, or after a misfire, when the gunner is compelled to reach across the gun to cock the firing mechanism. Subsequent firing automatically cocks it. Further caution is required when firing the gun at extreme position of elevation and traverse.

b. Up to 30 degrees elevation, the 37-mm gun can be served without depressing to load, with gunner standing on the bogie of the 155-mm carriage (figs. 148, 149, and 150). At higher elevations it is necessary to depress the primary weapon before loading is possible. Then, after fastening a lanyard to the trigger crank lever of the 37-mm gun, the 155-mm gun is raised to the desired elevation. The gunner can then fire the 37-mm gun by standing on the bogie and pulling the lanyard.

116. BORESIGHTING.

a. The subcaliber gun must be boresighted before each period of firing, and the alinement checked frequently during firing. It is important that both the 155-mm gun and subcaliber gun be boresighted before firing is commenced.

b. The procedure necessary to bring the axis of the bore of the subcaliber gun in coincidence with the bore of the 155-mm gun is as follows:

(1) Make a testing target by wrapping two pieces of black tape of equal width around the aiming post, with the lower edges exactly 14.60 inches apart. By the use of the aiming post as a testing target, it will not be necessary to level the 155-mm gun, as the aiming post can be canted to conform to the angle of the gun so that the vertical line of the bore of the gun will coincide with the side of the aiming post. The testing target should be placed about 50 yards from the gun.

(2) Use the bore sights to line up the bore of the 155-mm gun with the lower edge of the lower tape on the aiming post.

(3) Use the bore sights for the 37-mm subcaliber gun and sight it on the lower edge of the upper tape on the aiming post.

(4) All the adjustments of the 37-mm gun upon the testing target are made by the adjusting screws in the collar that encircles the recoil cylinder, and by those in the trunnion bearings. When tightening the screws, care must be taken not to place a strain upon the recoil cylinder, as it will become distorted and so prevent the subcaliber gun from returning fully to battery. After the bore sights are properly alined, fit the jam nuts up tight by tightening them intermittently instead of completely tightening one at a time.

Part Four — Auxiliary Equipment

117. ORGANIZATIONAL SPARE PARTS AND ACCESSORIES.

a. **Organizational spare parts.** The only spare parts issued with the subcaliber equipment are those which are liable to fail and which may readily be replaced by the using arms. These parts are specified in SNL C-33, section 13.

b. **Accessories.** The accessories provided for the subcaliber weapon are those required for the cleaning and preserving as well as for keeping a complete record of the equipment. They include a gun book, cartridge extractor, cleaning brush, oil gun, rammer, tool roll, etc.

APPENDIX

Section XXX

SHIPMENT AND STORAGE

118. GENERAL.

a. The 155-mm guns when mounted on carriages M1 and M2 will be shipped and stored in traveling position. Normally the 155-mm guns and mount T14 mounted on the 155-mm gun motor carriage T83 will be shipped and stored in their respective vehicles.

b. Preparation for domestic shipment and limited storage will be the same (par. 119). All precautions must be taken to prevent corrosion of materiel and deterioration of rubber during storage.

c. Materiel in limited storage is that materiel which is out of service for less than 30 days or that must be ready for operation on call.

d. Materials required for preparation for shipment and storage specified throughout this section are listed in section XIV, with the exception of items listed below:

COMPOUND, rust preventive, light

COMPOUND, rust preventive, thin film

TAPE, adhesive, nonhygroscopic, O. D.

119. PREPARATION FOR DOMESTIC RAILWAY SHIPMENT AND LIMITED STORAGE.

a. **Cleaning.** The materiel will be thoroughly cleaned and made free of all foreign matter as described below, using either dry-cleaning solvent, soda-ash, or a soap solution. Cleaning will include bearing surfaces, revolving parts, springs, screw threads, gear teeth, and exterior surfaces, as well as the interior of the breech ring and the bore of the gun. **NOTE:** *Partial disassembly of the breech and firing mechanisms will be in accordance with procedure outlined in sections XVII, XVIII, and XIX.*

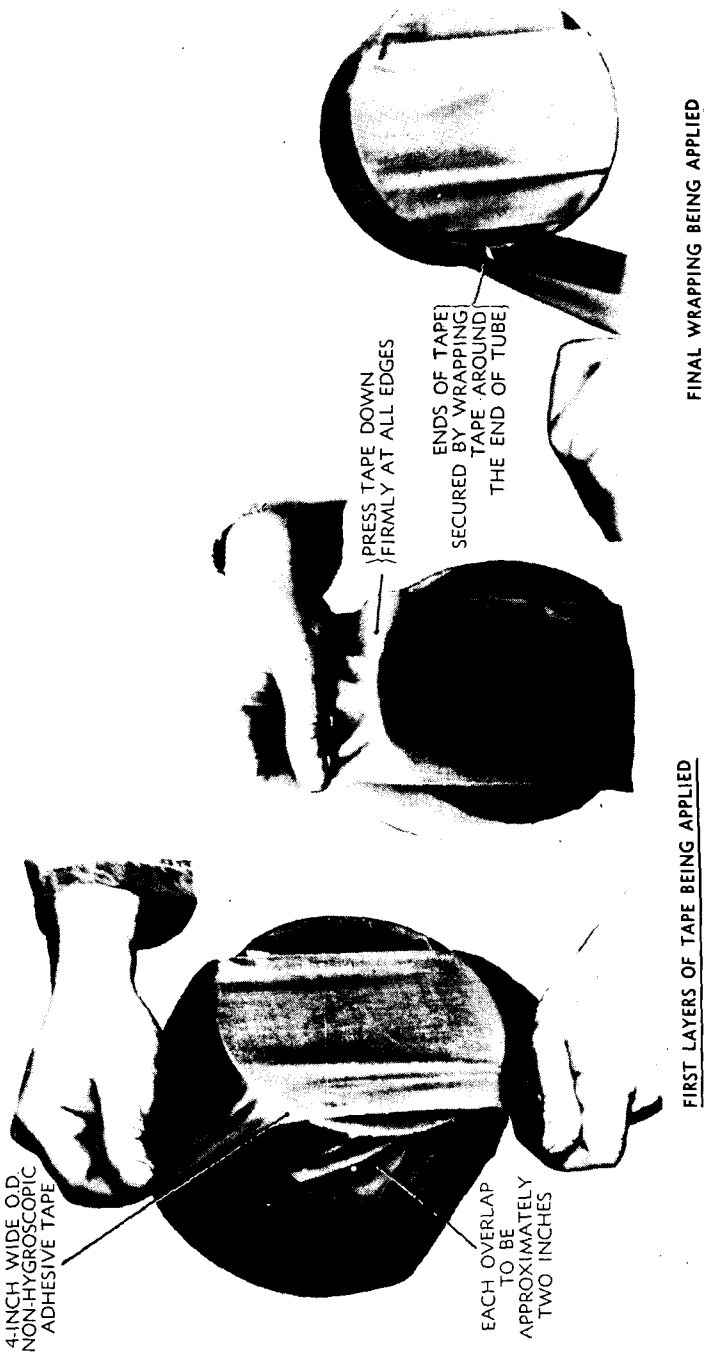
(1) Apply dry-cleaning solvent by scrubbing with a brush or wiping with a clean cloth. Dry all parts thoroughly.

(2) Apply either a warm soda-ash or a soap solution by brushing or scrubbing the surfaces thoroughly until all traces of contamination have been removed. The surfaces will then be rinsed with clean, warm water and thoroughly dried.

(a) For general cleaning purposes, soda-ash solution consists of $\frac{1}{2}$ pound of soda-ash in 2 gallons of warm water. For cleaning gun bores, solution will consist of $\frac{1}{2}$ pound of soda-ash in 1 gallon of warm water.

(b) Soap solution consists of 1 pound of castile soap or issue soap in chip form dissolved in 4 gallons of hot water.

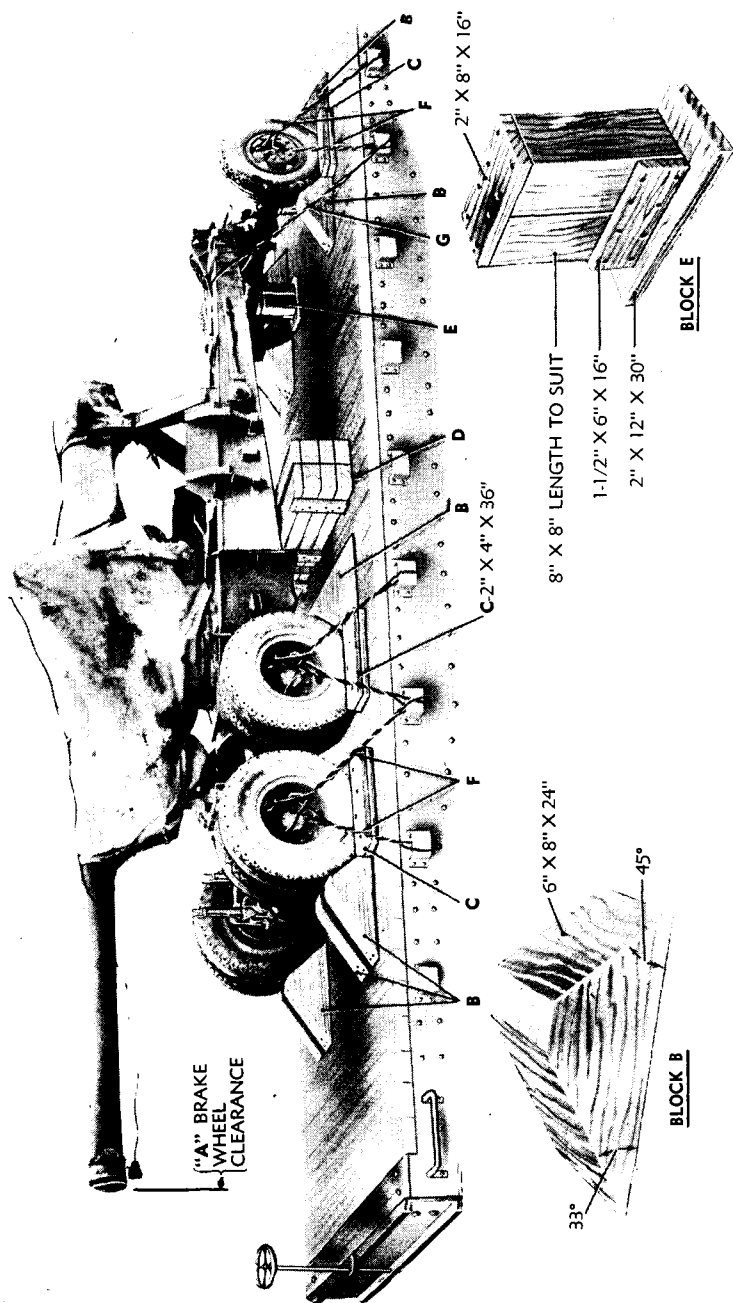
Appendix



RA PD 90439

Figure 151 — Method of Sealing Muzzle

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RA PD 82332

Figure 152 — Method of Blocking 155-mm Carriages M1 and M1A1 and Limber M5

Appendix

(3) Rifle-bore cleaner is used for cleaning artillery bores. It may be used in lieu of dry-cleaning solvent to clean other artillery parts and mechanisms. The cleaner is most efficiently used when undiluted, but when necessary to conserve supply, it may be diluted up to 50 percent with water. **NOTE:** *The standard bore brushes and cleaning accessories supplied with materiel are satisfactory for cleaning bores with rifle-bore cleaner.*

(4) Avoid contact of bare hands with cleaned surfaces. **NOTE:** *Under no circumstances will a hose, either normal or high pressure, be used in cleaning any sighting equipment or any fire control instruments. Before washing, take off removable sighting equipment from materiel to be cleaned. In cases where it is not removable, take care to cover the parts properly.*

b. Lubrication. The materiel will be completely lubricated before rail shipment or storage in accordance with Lubrication Order LO 9-350 (figs. 72 and 73), section XIII.

c. Removing rust spots. All painted surfaces that have become pitted or rusted will be thoroughly cleaned as follows:

(1) Aluminum-oxide abrasive cloth is used for cleaning unfinished external surfaces where wear of the parts cleaned will not affect the functioning of the mechanism.

(2) Crocus cloth is used for removing rust or stain and for polishing parts of the breechblock and firing mechanism and other finished operating surfaces.

d. Painting. Painted surfaces that have become checked, pitted, or rusted will have the rust spots removed and the surfaces cleaned and repainted.

e. Application of preservatives. Preservatives should be applied immediately after cleaning and drying, as a rust stain will form if materiel is handled between operations. Rust-preventive compound (light) used herein must be heated for proper fluidity before application. Refer to TM 9-850 for method of heating and application of rust-preventive compounds.

(1) **BREECH MECHANISM.** Where possible, the breech mechanism will be partially disassembled and parts dipped, sprayed, or brushed with rust-preventive compound (light). After assembly of the breech, apply a coating of rust-preventive compound (light) to the exterior portion.

(2) **GUN TUBE.** Swab the entire bore of the gun thoroughly with rust-preventive compound (light).

(3) **EXTERIOR UNPAINTED SURFACES.** Use rust-preventive compound (thin film) on exterior unpainted operating or machined surfaces from which the preservative can readily be removed. **NOTE:** *A certain amount of mechanical rubbing is required in addition to*

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solvent to effectively remove rust-preventive compound (thin film). This compound may be applied without heating. If the compound is applied by spraying, the rubber tires should be masked, using paper or masking tape for covering, or they should be removed before spraying operations.

f. Sealing.

(1) **MUZZLE.** Seal muzzle with nonhygroscopic adhesive tape (fig. 151). If this tape is not available, use canvas or burlap impregnated with rust-preventive compound (thin film), and tie or strap in place.

(2) **BREECH.** Seal breech with two layers of greaseproof wrapping material and overwrap with one layer of waterproof barrier wrapping paper. Secure by wrapping with nonhygroscopic adhesive tape. Spray over tape with rust-preventive compound (thin film).

g. Covers. Install all covers provided with the materiel and securely fasten.

h. Gun book.

(1) During transfer or shipment, the gun book must be kept in a waterproof envelope securely fastened to the cannon with nonhygroscopic adhesive tape.

(2) Under one of the wrappings of tape, one end of a small tab will be inserted, reading "Gun book here."

i. Tires.

(1) Remove all stones or other foreign objects from the tire treads.

(2) Rubber equipment must be kept free from oils, greases, and preservatives.

j. Inspections.

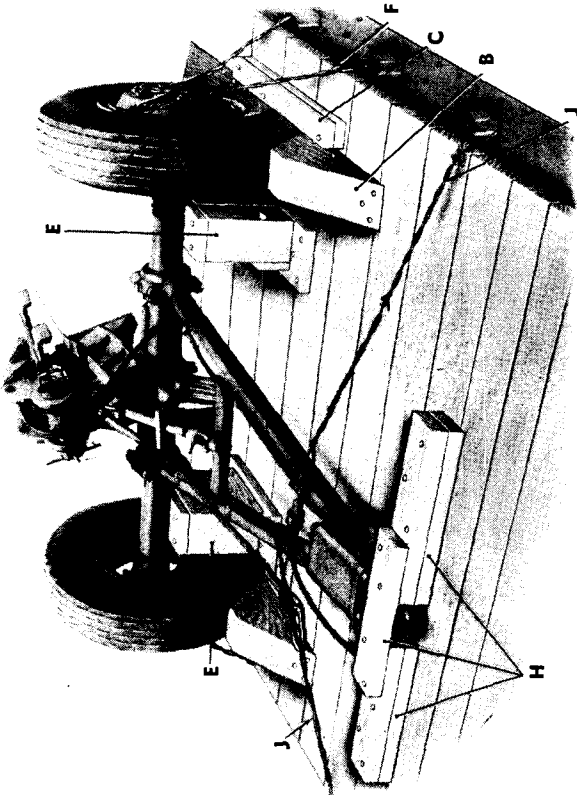
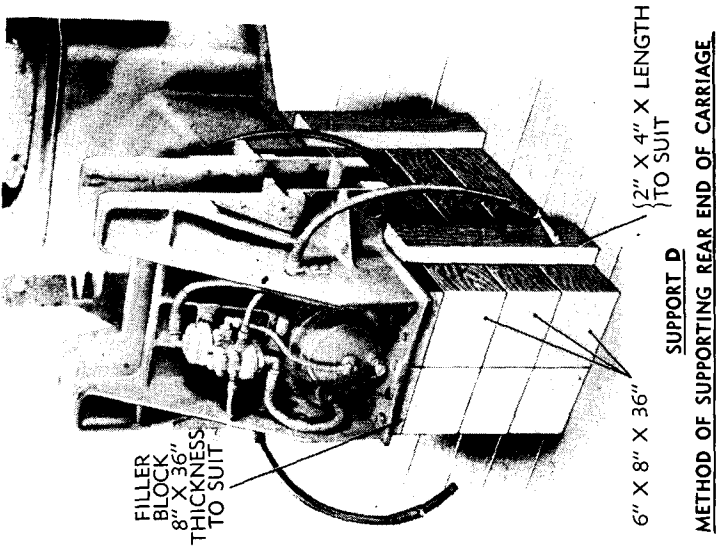
(1) **GENERAL.** Make a systematic inspection before shipment or storage. All broken or missing parts will be promptly repaired and/or replaced. If repairs cannot be made prior to placing materiel in storage, a tag will be attached to materiel, specifying the repairs needed, and a written report of these items will be made to the officer in charge of the materiel.

(2) **LIMITED STORAGE.**

(a) *Periodical inspection.* A visual inspection will be made weekly during storage to determine general condition. If corrosion is found on any part, remove the rust spots (subpar. c, above), and treat with the prescribed preservative.

(b) *Tires.* All tires will be cleaned, inspected, and properly inflated. Tires requiring repairing or treading will be replaced with serviceable tires. Materiel will not be stored on floors, cinders, or other surfaces which are soaked with oil or grease. Any oil, grease,

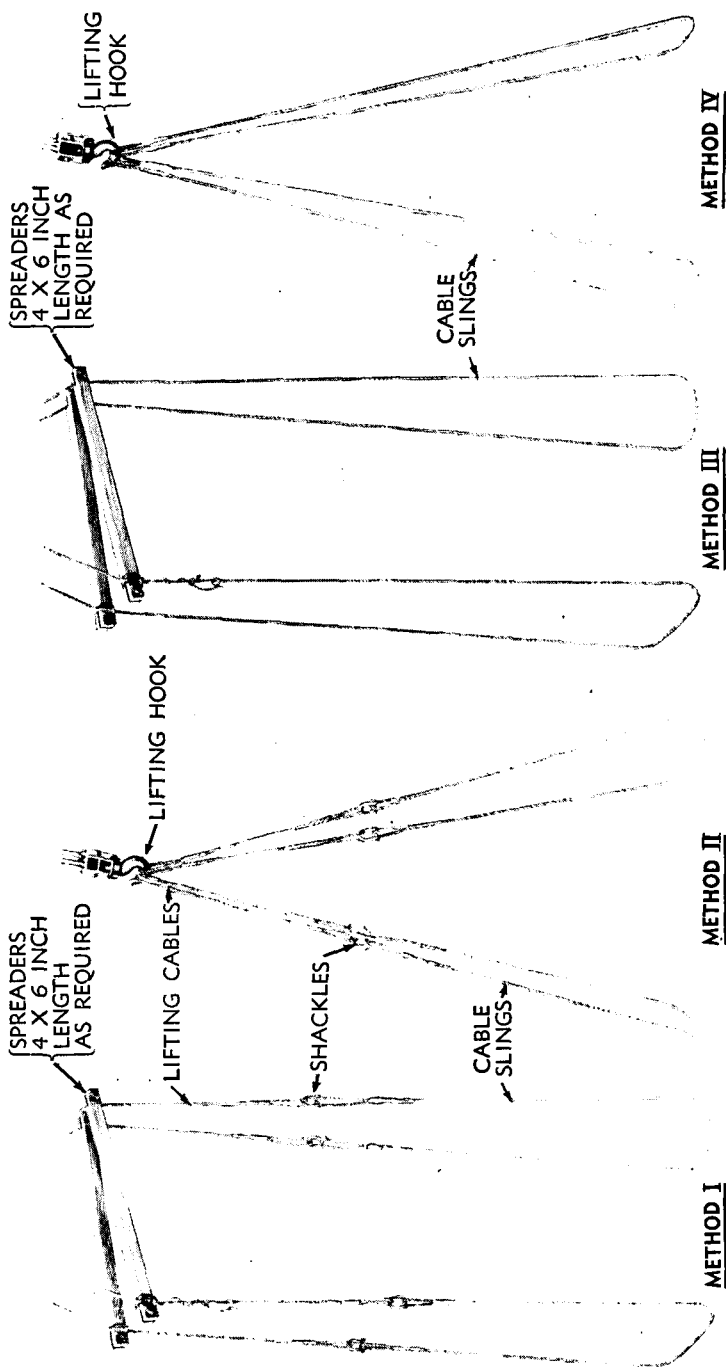
Appendix



RA PD 82333

Figure 153 — Details of Blocking Carriages M1 and M1A1 and Limber M5

Appendix



RA PD 96035

Figure 154 — Sling Methods Used in Hoisting Artillery Material

Appendix

gasoline, or solvent which comes in contact with tires under any circumstances, will be washed off immediately.

k. Removal from storage.

(1) Remove all seals and tape. Remove preservative using dry-cleaning solvent. Dry thoroughly after cleaning and lubricate in accordance with Lubrication Order (figs. 72 and 73).

(2) Repair and/or replace all items tagged in accordance with subparagraph j (1), above.

120. LOADING RULES AND BLOCKING REQUIREMENTS FOR RAIL SHIPMENT.

a. General. Materiel to be loaded and blocked on railroad cars for rail shipment will be prepared in accordance with instructions given in paragraph 119. All loading and blocking instructions as specified herein are minimum. Additional blocking as required may be added at the discretion of the officer in charge.

b. Inspection. Railroad cars must be inspected to see that they are suitable to carry loads safely to destinations. Floors must be sound and all loose nails or other projections, not an integral part of the car, should be removed. Nails, bolts, etc., necessary in car construction, when loose, should be made tight rather than removed.

c. Ramps. Permanent ramps should be used for loading the materiel, but when such ramps are not available, they may be improvised from rail ties and other available lumber.

d. Handling.

(1) Cars loaded in accordance with specifications given herein must not be handled in hump switching.

(2) Cars must not be cut off while in motion, and must be coupled carefully, to avoid all unnecessary shocks.

(3) Cars must be placed in yards or on sidings so that they will be subjected to as little handling as possible. Separate track or tracks, when available, must be designated at terminals, classification, or receiving yards for such cars, and cars must be coupled at all times during such holding and hand brakes set.

e. Clearing limits. The height and width of load must be within the clearance limits of the railroads over which it is to be moved. Army and railroad officials must check all clearances prior to each move.

f. Maximum load weights. In determining the maximum weight of load, the following shall govern, except where load weight limit has been reduced by the car owner.

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Marked Capacity of Car (lb)	Total Weight of Car and Load (lb)	Load Weights (Deduct Lt. Wt. of Car) (lb)
40,000	66,000	66,000
60,000	103,000	103,000
80,000	136,000	136,000
100,000	169,000	169,000
140,000	210,000	210,000
200,000	251,000	251,000

EXAMPLE

	Pounds
Capacity of car	100,000
Total weight of car and load	169,000
*Light weight of car (to be subtracted)	37,000
Permissible weight of load	132,000

g. Brake wheel clearance (A, fig. 152). Load should clear the brake wheel as much as possible, but must not be less than 4 inches below nor less than 6 inches above, in back and on both sides of the brake wheel. Brake wheel clearance will be increased as much as is consistent with proper location of load.

h. Distribution of load. Materiel must be so placed on the car that there will not be more weight on one side of the car than on the other. One truck of the carrying car must not carry more than one-half of the load weight. *NOTE: When loading railroad cars, materiel shall be so loaded as to require a minimum number of cars. To accomplish this, various types of materiel may be loaded on the same car provided all have the same destination.*

i. Tire pressure. For shipment by rail, the tire pressure shall be increased 10 pounds per square inch above normal.

j. Type of car. Flat or drop-end gondola cars may be used.

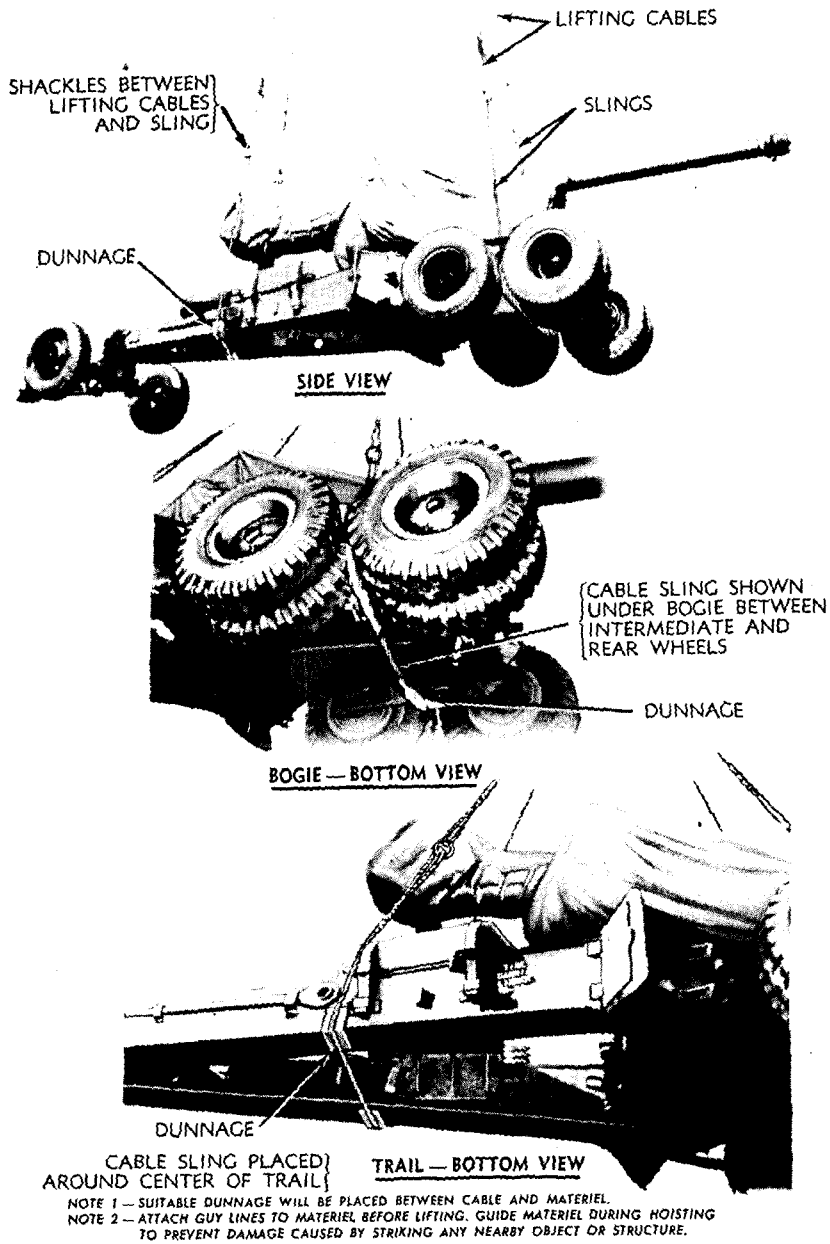
k. Brakes. After loading the materiel, set the hand brakes.

l. Blocking the 155-mm carriages M1 and M1A1 and limber M5. All blocking pieces shall be of sound straight-grained wood. (All item reference letters given below refer to the details and locations in figures 152 and 153.)

(1) **BLOCKS B, PATTERN 3.** Twelve are required, 6 x 8 x 24 inches. Locate the 45-degree portion of the blocks against the front and rear of the limber wheels, in front of the intermediate bogie wheels and in back of the rear bogie wheels. Nail heel of block to car floor with three forty-penny cement-coated nails, and toenail one side of the block to the car floor with two forty-penny cement-coated nails before cleats C are applied.

*This marking is stenciled on each side of car as "Lt. Wt."

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RA PD 102951

Figure 155 — Method of Slinging 155-mm Gun Materiel

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(2) **CLEATS C, PATTERN 2.** Twelve are required, 2 x 4 x 36 inches. Locate two cleats against the face of the outside wheels. Nail lower cleat to car floor with four thirtypenny cement-coated nails, and top cleat to the lower cleat and car floor with four thirtypenny cement-coated nails.

(3) **SUPPORTS D.** Three are required, 16 x 36 inches, height to suit. Place one support under each side of trail crosswise of car and one under the rear end of gun carriage lengthwise of car. The height of the support should be slightly higher than the distance between the materiel and car floor to partially relieve weight on tires. Toenail the support to the car floor with four forty penny cement-coated nails on each side.

(4) **BLOCKS E.** Two are required, 12 x 30 inches, height to suit. Place supports under the limber axle lengthwise of car close to each wheel. Height shall be $\frac{1}{4}$ inch higher than distance between the axle and car floor to partially relieve weight on tires. Nail support to the car floor, using 10 forty penny cement-coated nails.

(5) **WHEEL STRAPPING F (12) WIRES.** Loop two wires, consisting of four strands of No. 8 gage, black annealed wire each, through the holes in the wheel and through opposite stake pockets (fig. 152). Bring ends of wire together and twist taut with rod or bolt enough to remove slack.

(6) **TRAIL STRAPPING G.** Two are required. Loop one wire consisting of six strands of No. 8 gage, black annealed, around one side of trail and through stake pocket. Bring ends together and twist taut with rod or bolt enough to remove slack. Repeat operation to other side of trail.

(7) **METHOD OF BLOCKING LIMBER M5.**

(a) **Cleats H.** Five are required, 2 x 4 x 24 inches. Locate two cleats on each side of the lunette. Nail lower cleats to car floor with four thirtypenny cement-coated nails, and top cleat to the lower cleat and car floor with four thirtypenny cement-coated nails. Center one cleat above lunette ring and nail each end to the side cleats with four thirtypenny cement-coated nails.

(b) **Drawbar strapping J.** One is required. Loop one wire consisting of six strands of No. 8 gage, black annealed wire around drawbar and through stake pockets on each side of car. Bring ends together and twist taut with rod or bolt just enough to remove slack.

121. METHODS OF SLINGING 155-MM GUN MATERIEL.

a. General.

(1) These instructions prescribe procedures, methods, and practices to be followed when the materiel is hoisted, and describe the proper attachment points for slings to permit the materiel to be hoisted in its normal position.

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(2) Covers supplied with materiel will be installed and securely fastened.

(3) If operations embrace deep water fording, materiel will be prepared in accordance with TM 9-2853.

(4) For methods in stevedoring, refer to TM 55-310.

b. Sling methods.

NOTE: Due to varying conditions encountered in the field, any of the following procedures may be used, where applicable.

(1) **METHOD I** (fig. 154). Method I employs the following materials:

- (a) Cable slings (heavy enough to support materiel).
- (b) Shackles (placed between lifting cables and slings).
- (c) Lifting cables.
- (d) Lifting hook.
- (e) Cargo runners.

(f) Spreaders (4 in. x 6 in., length as required). Spreaders are used between cables to obtain a better balance and to provide clearance between slings and materiel to prevent damage when materiel is hoisted. Spreaders consist of two pieces of oak or other hardwood with open ends as shown in figure 154, and are positioned on the cables leading from the lifting hook at a point which will provide clearance between slings and materiel. Slings are placed around materiel at the proper points of balance and attached to the shackles on the lifting cables.

(2) **METHOD II** (fig. 154). Special care must be exercised, when this method is used, to see that proper clearance for fire control brackets, gears, and operating surfaces is maintained when materiel is hoisted clear of ground. Method II employs the following materials:

- (a) Cable slings (heavy enough to support materiel).
- (b) Shackles (placed between lifting cables and slings).
- (c) Lifting cables.
- (d) Lifting hook.
- (e) Cargo runners.

(3) **METHOD III** (fig. 154). Method III employs the following materials:

- (a) Cable slings (heavy enough to support materiel).
- (b) Lifting hook.
- (c) Cargo runners.

(d) Spreaders (4 in. x 6 in., length as required). Spreaders are used between cables to obtain a better balance and to provide clearance between slings and materiel to prevent damage when materiel is hoisted. Spreaders consist of two pieces of oak or other hardwood

Appendix

with open ends as shown in figure 154, and are positioned on the cables leading from the lifting hook at a point which will provide clearance between slings and materiel.

(4) **METHOD IV** (fig. 154). Special care must be exercised when this method is used, to see that proper clearance for fire control brackets, gears, and operating surfaces is maintained when materiel is hoisted clear of ground. Method IV employs the following materials:

- (a) Cable slings (heavy enough to support materiel).
- (b) Lifting hook.
- (c) Cargo runners.

c. Cautions during hoisting of materiel.

(1) Before attempting to hoist materiel, an examination of hoisting cables must be made to determine their condition. If strands of cable are broken at any point, a new cable must be substituted. Kinked cables which will not straighten out without damage should not be used.

(2) Under no circumstances must materiel be hoisted when it is found that all weight is balanced on one sling (other sling being loose). Materiel must be lowered to the ground and slings placed in the proper position.

(3) Do not place slings around gun tubes for hoisting purposes.

(4) All damageable instruments such as fire control equipment, gun sights, etc., must be removed from materiel and securely stowed. *It is imperative that all stowage boxes, tires, or other loose equipment be securely strapped to materiel prior to movement.*

(5) If the underside of materiel has sharp edges at the points where slings are placed, insert dunnage consisting of wood blocks, sacking, clean cloth, or similar material between the slings and materiel in order to prevent cable strands from cutting or slipping.

(6) Attach guy lines to materiel before lifting. Guide materiel during hoisting to prevent damage caused by striking any nearby object or structure.

d. Method of slinging 155-mm gun materiel.

(1) Detach one end of cable slings from shackles on lifting cables.

(2) Place detached end of one cable sling under bogie between the intermediate and the rear wheels across width of carriage, and attach to shackle.

(3) Place detached end of other cable sling around center of trails and attach to shackle.

(4) Locate dunnage as described in subparagraph c (5), above.

(5) Attach guy lines (subpar. c (6), above), and hoist materiel slowly, observing proper balance (subpar. c (2), above).

Appendix

Section XXXI

REFERENCES

122. PUBLICATIONS INDEXES. The following publications indexes should be consulted frequently for latest changes or revisions of references given in this section and for new publications relating to materiel covered in this manual:

- a. Ordnance Supply Catalog Index (index to SNL's)
ASF Cat. ORD 2
- b. Ordnance Major Items and Combinations, and
Pertinent Publications SB 9-1,
- c. List and Index of War Department Publications
(listing CCBP's, FM's, FT's, MTP's, TB's,
TM's, TR's, TC's, and LO's, new AR's, Cir's,
GO's, and WDB's, T/O&E's, T/O's, T/E's,
T/A's, T/BA's, MR's, RR's, WDP's, SB's,
MWO's, and Forms) FM 21-6
- d. List of Training Films, Film Strips, and Film
Bulletins FM 21-7
- e. Military Training Aids (listing graphic training
aids, models, devices, and displays)..... FM 21-8

123. STANDARD NOMENCLATURE LISTS.

a. Ammunition.

Ammunition, fixed and semifixed, including sub-caliber, for pack, light, and medium field, air-craft, tank, and antitank artillery, including complete round data.....ASF Cat. ORD 11 SNL R-1

Ammunition, fixed, including subcaliber ammunition, for harbor defense, heavy field, and railway artillery ASF Cat. ORD 11 SNL P-6

Ammunition instruction material for antiaircraft, harbor defense, heavy field, and railway artillery, including complete round data
ASF Cat. ORD 11 SNL P-8

Charges, propelling, separate loading, 6-in. to 240-mm inclusive, for harbor defense, heavy field and railway artillery....ASF Cat. ORD 11 SNL P-2

Appendix

Fuzes, primers, blank ammunition, and miscellaneous items for antiaircraft, harbor defense, heavy field, and railway artillery

ASF Cat. ORD 11 SNL P-7

Projectiles, separate loading, 6-in. to 240-mm inclusive, for harbor defense, heavy field, and railway artillery, including complete round data

ASF Cat. ORD 11 SNL P-1

Service fuzes and primers for pack, light and medium field, aircraft, tank, and antitank artillery

ASF Cat. ORD 11 SNL R-3

Slide, M1: TABLE, fixing, graphical

ASF Cat. ORD (*) SNL F-237

- b. Cleaning, preserving and lubricating materials; recoil fluids, special oils, and miscellaneous related items

ASF Cat. ORD 5 SNL K-1

c. **Gun materiel.**

Gun, 155-mm, M1, M1A1, and M2; carriage, gun, 155-mm, M1; limber; carriage, heavy, M2 and M5; and platform, firing, 155-mm gun, M1

ASF Cat. ORD (*) SNL D-24

Gun, 37-mm, M1916..... ASF Cat. ORD (*) SNL C-33
Section 13

d. **Sighting and fire control equipment.**

Circle, aiming, M1..... ASF Cat. ORD (*) SNL F-160

Light, aiming post, M14.... ASF Cat. ORD (*) SNL F-205

Light, instrument, M5..... ASF Cat. ORD (*) SNL F-205

Light, instrument, M12..... ASF Cat. ORD (*) SNL F-205

Light, instrument, M19..... ASF Cat. ORD (*) SNL F-205

Mount, quadrant, M1..... ASF Cat. ORD (*) SNL F-180

Mount, telescope, M18A1.. ASF Cat. ORD (*) SNL F-180

Posts, aiming ASF Cat. ORD (*) SNL F-35

(*) See ASF Catalog Ord 2 Index for published pamphlets of the Ordnance Supply Catalog.

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Quadrant, gunner's, M1 (mils)	ASF Cat. ORD (*) SNL F-140
Quadrant, elevation M1....	ASF Cat. ORD (*) SNL F-204
Quadrant, gunner's, M1918 (mils)	ASF Cat. ORD (*) SNL F-13
Telescope, B. C., M1915A1	ASF Cat. ORD (*) SNL F-9
Telescope, panoramic, M5A5	ASF Cat. ORD (*) SNL F-22
Telescope, panoramic, M12	ASF Cat. ORD (*) SNL F-214

124. EXPLANATORY PUBLICATIONS.**a. Ammunition.**

Ammunition, General	TM 9-1900
Artillery Ammunition	TM 9-1901
Meteorology for Artillery.....	TM 20-240
Qualifications in Arms and Ammunition Training Allowances	AR 775-10
Range Regulations for Firing Ammunition for Training and Target Practice	AR 750-10

b. Fire control.

Auxiliary Fire Control Instruments (Field Glasses, Eyeglasses, Telescopes and Watches)...	TM 9-575
Field Artillery Fire-control Instruments.....	TM 6-220
Graphical Firing Tables	TM 9-526

c. Cleaning, Preserving, Sealing, Lubricating and Related Materials Issued for Ordnance Materiel

.....	TM 9-850
Preparation of Ordnance Materiel for Deep Water Fording	TM 9-2853
Ordnance Packaging and Shipping (Posts, Camps, and Stations)	TM 9-2854
Preparation of Unboxed Ordnance Materiel for Shipment	SB 9-4

(*) See ASF Catalog Ord 2 Index for published pamphlets of the Ordnance Supply Catalog.

*Appendix***d. General.**

Basic Maintenance Manual	TM 37-250
Decontamination	TM 3-220
Defense Against Chemical Attack.....	FM 21-40
Dictionary of United States Army Terms.....	TM 20-205
Maintenance and Care of Pneumatic Tires.....	TM 31-200
Standard Artillery and Fire Control Materiel.....	TM 9-2300
Instruction Guide: Welding—Theory and Appli- cation	TM 9-2852

e. Shipment and storage.

Compressed Gas Cylinders.....	AR 850-60
Explosive, Inflammable or Dangerous Articles.....	AR 55-155
Marking, Oversea Movement	AR 55-390
Marking, Oversea, Portbound	AR 55-105
Stock Control Manual for Stations.....	TM 38-220
Service of the Piece.....	FM 6-90
Service of the Piece.....	FM 4-24
Gunnery	FM 4-10
Stevedoring	TM 55-310

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